LAC-IEE-12-41

ENVIRONMENTAL THRESHOLD DECISION

Activity Location:	Guatemala
Activity Title:	Agricultural Activities under Country Development Cooperation Strategy - Objective No. 2: Improved Levels of Economic Growth and Social Development in the Western Highlands
Activity Number:	(formerly 520-021)
Life-of-Activity Funding:	$115million
Life-of-Activity:	FY 2012 – FY 2017
Reference ETDs:	LAC-IEE-04-46; LAC-IEE-11-69, LAC-IEE-12-11
Recommended Threshold Decision:	Negative Determination with Conditions
Bureau Threshold Decision:	Negative Determination with Conditions

Comments:

This Environmental Threshold Decision amends the above ETDs for the use of pesticides any of the Mission's agricultural activities, (e.g., the Rural Value Chains Project).

A **Negative Determination with Conditions** is issued for the use of pesticides with any of the Mission's agricultural activities (e.g., the Rural Value Chains Project), pursuant to 22 CFR 216.3(b). Conditions include:

- USAID/Guatemala will follow the recommendations of the attached Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP).

- The mission and its partners will promote and apply organic approaches and Global GAP methods to pesticide use and agricultural production.

- This Threshold Decision does not approve the following pesticides recommended by the

attached Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP). See the attached comments on the PERSUAP. Please edit the PERSUAP accordingly and send the revised document to the BEO and other parties.

	PESTICIDE	REASON FOR NOT APPROVING
o	Boscalid + Pyraclostrobin (Bellis 38 WG)	Formulation not registered with EPA
o	Dimethoate	Not recommended for a particular crop, not included in the IPM plans in Annex 1

- Any additional pesticides will require an IEE amendment for the pesticide analysis according to 22 CFR 216.3(b)

- The PERSUAP will be translated into Spanish for use by all stakeholders in the country. Training and other applicable materials for farmers and extension agents will also be developed in Spanish as well as any local (Maya) languages as appropriate.

- Individual Partners must develop their own Safe Use Action Plans (SUAPs), which MUST be consistent with this PERSUAP, and which must be approved by both the Mission Environmental Officer and the respective COR/AOR. See Section 4 of the PERSUAP.

Conditions also include:

Responsibilities

- Each activity manager or **Contracting (or Agreement) Officer Representative (COR/AOR)** is responsible for making sure environmental conditions are met (ADS 204.3.4). In addition, COR/AORs are responsible for ensuring that appropriate environmental guidelines are followed, mitigation measures in the IEE are funded and implemented, and that adequate monitoring and evaluation protocols are in place to ensure implementation of mitigation measures.

- It is the responsibility of the **Development Objective (SO) Team** to ensure that environmental compliance language from the ETD is added to procurement and obligating documents, such as activity-related Development Objective Grant Agreements (DOAGs), program descriptions, and statements of work.

- The **Mission Environmental Officer** will conduct spot checks to ensure that conditions in the IEE and this ETD are met. These evaluations will review whether guidelines are properly used to implement activities under this ETD in an environmentally sound and sustainable manner according to USAID and applicable U.S. Government policies and regulations.

- The implementing **contractor or partner** will ensure that all activities conducted under

this instrument comply with this ETD. Also, through its regular reporting requirements, a section on environmental compliance (e.g. mitigation monitoring results) will be included.

Amendments

- Amendments to Initial Environmental Examinations (IEE) shall be submitted for LAC Bureau Environmental Officer (BEO) approval for any activities not specifically covered in the IEE, which include:
    - Funding level increase beyond ETD amount,
    - Time period extension beyond ETD dates (even for no cost extension), or
    - A change in the scope of work, such as the use of pesticides or activities subject to Foreign Assistance Act sections 118 and 119 (e.g. procurement of logging equipment), among others.

Victor H. Bullen Date Aug 15, 2012
Victor H. Bullen
Bureau Environmental Officer
Bureau for Latin America and the Caribbean

_____ Date _____
Victor H. Bullen
Bureau Environmental Officer
Bureau for Latin America and the Caribbean

Copy to: Kevin Kelly, USAID/Guatemala Mission Director
Nancy Hoffman, DMD
Liliana Gil, PPS
Jeffrey Lehrer, PPS
Teresa Robles, MEO

Copy to: Paul Schmidtke, Regional Environmental Advisor, USAID/El Salvador

Copy to: Nancy Eslick, Julie Ciccarone LAC/CAM
Tracy Quilter, LAC/RSD/BBEG
Erika Clesceri, DCHA/BEO

Copy to: IEE File

Attachment: Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP)
Memo with the Mission approval of the Initial Environmental Examination/PERSUAP

File: LAC.RSD.PUB\RSDPUB\EES\Reg216\IEE\IEE12\ LAC-IEE-12-41 ETD (GU - PERSUAP, amend LAC-IEE-04-46; 11-69, 12-11).doc

USAID | GUATEMALA
FROM THE AMERICAN PEOPLE

TO: Kevin Kelly, Mission Director USAID/Guatemala

DATE: August 2, 2012

FROM: Mark Visocky, Director, Economic Growth Office

SUBJECT: Approval of the Economic Growth Program Pesticide Evaluation Report and Safe Use Action Plan (PERSUAP)

Action Requested: That you authorize the attached Pesticide Evaluation Report and Safe Use Action Plan which addresses the analytical requirements required of all USAID pesticide activities, as spelled out in USAID's Pesticide Procedures [22 CFR 216.3 (b)(1)(i)], and also recommends measures to reduce pesticide risks in this activity to the extent practicable.

Background: Because of risk concerns presented by pesticides, the USAID environmental regulations require that at least the 12 factors outlined in the Pesticide Procedures described in 22 CFR 216.3 (b)(1)(i) (a through l) be addressed in the IEE for any program that includes assistance for the procurement or use of pesticides. A "Pesticide Evaluation Report and Safer Use Action Plan" (PERSUAP), is submitted as an attachment to the IEE. The PERSUAP focuses on the particular circumstances of the programs in question, the risk management choices available, and how a risk management plan would be implemented in the field.

The attached Programmatic Pesticide Evaluation Report and Safe Use Action Plan (PERSUAP) intends to help close any informational gaps that may be present concerning pesticide utilization in USAID/Guatemala agriculture development projects as well as to ensure compliance with USAID's environmental regulations (Title 22 of the Code of Federal Regulations (CFR), part 216, or Regulation 216). The previous PERSUAP covering economic growth programs (EGP) in Guatemala was written in 2001, and requires updating.

Description: The purpose of the attached document is to conclude the process of having a programmatic Pesticide Evaluation Report and Safe Use and Action Plan (PERSUAP) in compliance with 22 CFR 216.3 (b)(1)(i) (a through l) for Guatemala, which is the final version that includes all the comments and corrections requested by the Bureau Environmental Officer (BEO) and Regional Environmental Advisor (REA).

The Pesticide Evaluation Report section addresses the 12 informational elements required in the Agency's Pesticide Procedures. The Safer Use Action Plan incorporates the conclusions reached in the PER into an action plan that includes assignment of responsibility to appropriate parties connected with the pesticide program. This analysis covers those pesticides proposed for use by the USAID/Guatemala agriculture development projects that are:

- Registered by US Environmental Protection Agency (EPA) for the same or similar uses without restrictions
- Registered by the Government of Guatemala
- Available in Guatemala and can be included in Integrated Pest Management (IPM) planning

Discussion: Having a PERSUAP gives the Mission the opportunity to consider practical actions by which to reduce the risks of using pesticide products in its programs, taking into consideration the context in which the products will be used, the particular elements of the programs, and the different capacities of the partners involved.

By training partners in Good Agricultural Practices, USAID can reduce the need to use of pesticides. Actions such as proper crop spacing, crop rotation, and others can significantly lower the need for chemical intervention. While the use of chemical pesticides/herbicides/fungicides may sometimes be unavoidable, a large focus of USAID/Guatemala's PERSUAP is on Integrated Pest Management (IPM) which includes the utilization of commercialized substances whose active ingredients (AI) are naturally occurring. These naturally occurring ingredients can be as effective as synthetic ingredients and represent less risk to farmers and consumers.

The PERSUAP provides a list of the crops grown or likely to be grown by projects, all of the major pests and diseases impacting each of these crops, and all of the IPM tactics (including recommended pesticides) that can be used for these specific crop pests and diseases.

This PERSUAP also analyzes the 287 AIs in 3,677 natural and synthetic pesticides currently registered and imported into Guatemala. This list can be compared to those products certified by the EPA, thus allowing USAID and implementing partners to make informed decisions on the respective product's deployment. This analysis also provides resources to obtain internationally recognized Maximum Residue Levels to determine allowable levels of specific pesticides on specific crops for consumption and export.

Recommendation: That you sign below and thereby authorize the "Economic Growth Program Pesticide Evaluation Report and Safe Use Action Plan" in order to respond to the requirements included in 22 CFR 216.3 (b)(1)(i)].

Approved by: _____ Date: 8/10/2012
Kevin Kelly
Mission Director

Disapproved by: _____ Date: _____
Kevin Kelly
Mission Director

Clearances:

Mark Visocky, DirEGO		Date: 8/6/2012
Teresa Robles, MEO	Teresa Robles V	Date: 8/6/2012
Liliana Gil, PPS		Date: 8/7/2012
Jeffrey Lehrer, DirPPS		Date: 8/8/2012
Paul Schmidtke, REA	BY E-MAIL	Date: 8/8/2012
Nancy L. Hoffman DMD	8/10/2012 nlh	Date:

LAC-IEE-12-41

USAID
FROM THE AMERICAN PEOPLE

GUATEMALA ECONOMIC GROWTH PROGRAM

PESTICIDE EVALUATION REPORT AND SAFE USE ACTION PLAN (PERSUAP)

October 2010
This report was produced for review by the United States Agency for International Development (USAID). It was prepared by International Resources Group (IRG), subcontractors to Abt Associates.

July 2012
Final version revised by USAID Economic Growth staff.

GUATEMALA ECONOMIC GROWTH PROGRAM

PESTICIDE EVALUATION REPORT AND SAFE USE ACTION PLAN (PERSUAP)

October 2010

Principal Authors – IRG subcontractor to Abt Associates

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July 2012

Final version revised by USAID Economic Growth staff.

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ACRONYMS

AI	Active Ingredient
ANACAFE	National Association of Coffee Producers
APHIS	Animal Plant Health Inspection Service (USDA)
BMP	Best Management Practice
BT	Bacillus thuringiensis (a bacterial pesticide)
CAFTA-DR	Dominican Republic-Central America Free Trade Agreement (also DR-CAFTA)
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
COP	Chief of Party
CP3	Cleaner Production and Pollution Prevention
DR	Dominican Republic
EA	Environmental Assessment
EGP	Guatemala Economic Growth Program
EPA	US Environmental Protection Agency (also known as USEPA)
FAO	Food and Agriculture Organization (United Nations agency)
FAS	Foreign Agricultural Service (USDA)
FDA	Food and Drug Administration (US)
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
GAP	Good Agriculture Practice
GBP	Good Business Practice
GMP	Good Manufacturing (Processing) Practice
GUP	General Use Pesticide
HT	Highly Toxic
ICM	Integrated Crop Management
ICM	Integrated Crop Management
IEE	Initial Environmental Examination

IGR	Insect Growth Regulator
IPM	Integrated Pest Management
IRG	International Resources Group
ISFM	Integrated Soil Fertility Management
IUCN	International Union for Conservation of Nature
IVM	Integrated Vector Management
IWM	Integrated Weed Management
M&E	Monitoring and Evaluation
MAGA	Ministerio de Agricultura, Ganadería y Alimentación (Ministry of Agriculture)
MARN	Ministry of Environment and Natural Resources
MEO	Mission Environmental Officer
MRL	Maximum/Minimum Residue Level/Limit
MSDS	Material Safety Data Sheet
MSPAS	Ministerio de Salud Publica y Assistancia Social (Ministry of Health)
MSPAS	Ministry of Health
MT	Moderately Toxic
NAT	Not Acutely Toxic
NEPA	National Environmental Policy Act (US)
NPV	Nuclear Poliedrosis Virus
PAN	Pesticide Action Network
PER	Pesticide Evaluation Report
PERSUAP	Pesticide Evaluation Report and Safe Use Action Plan
pH	- log of Hydrogen ion concentration, measure of acidity
PIC	Prior Informed Consent (a treaty, relates to toxic pesticides)
PIPAA	Integrated Program for Agricultural and Environmental Protection
PMP	Pest Management Plan
PNT	Practically Non-Toxic
POPs	Persistent organic pollutants
POPs	Persistent Organic Pollutants (a treaty, relates to toxic persistent pesticides)

PPE	Personal Protection Equipment
R&D toxin	Reproductive and Developmental toxin
REDD	Reduced emissions from deforestation and degradation
Reg 216	Regulation 216 (USAID Environmental Procedures)
REI	Re-Entry Interval (safety period after pesticide spraying)
RUP	Restricted Use Pesticide
S&C	Standards and Certification
SMEs	small and micro-enterprises
SPS	Sanitary and Phytosanitary
ST	Slightly Toxic
SUAP	Safe Use Action Plan
UN	United Nations
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
USEPA	US Environmental Protection Agency (also known as EPA)
USG	United States Government
VHT	Very Highly Toxic
WHO	World Health Organization
WTO	World Trade Organization

ACKNOWLEDGEMENTS

This Guatemala Economic Growth Program (EGP) PERSUAP was prepared by Alan Schroeder, IRG consultant, with field assistance from Guatemalan Agricultural Specialists Ramiro and Manfredo Lopez, both with Master of Science degrees. This document was further amended and updated during April-June 2012 by the USAID\Guatemala Economic Growth Team. Analyzing all of these crops, pests, GAP and IPM methods, resource conservation practices, and pesticides would have been impossible without the direct support of the world-class experts who have helped guide data collection and interpretation. Alan, Manfredo, and Ramiro would like to thank Abt Associates and IRG staff for their considerable assistance in the field during the formation of the study. Special thanks go to Carmen María Lopez, Juan Carlos Méndez, and Janet I. de Esquivel for providing expert coordination experience, accompanying the team to the field and advice on the Guatemala agriculture projects.

Special thanks also go to Anne Lewandowski and Laurie Chamberlain of IRG Headquarters as well as USAID/Guatemala CTO Ana Vilma Pocasangre, Asesora en Desarrollo de Empresas Rurales Glenda Paiz, MEO Teresa Robles, and Agriculture Advisor Michael Lofstrom as well as USAID/Central America Regional Environmental Advisor Paul Schmidtke for guidance and advice. Staff of Anacafe, Fundacion AGIL, AGEXPORT, Mercy Corps, PIPAA, MAGA, Ministry of Envrionment/CAFTA, USDA/APHIS, USDA/FAS/SPS, SGS Certifiers, AgreQuima, Bayer Life Sciences and Ministry of Health Certified Laboratories were very patient answering the teams questions. Thanks to numerous input retailers, cooperatives, certifiers, and producers who patiently met with us and answered our questions.

EXECUTIVE SUMMARY

Introduction

This Programmatic Pesticide Evaluation Report and Safe Use Action Plan (PERSUAP) intends to help further fill the information and knowledge gaps where pesticides are concerned on USAID/Guatemala agriculture development projects, and ensure compliance with USAID's environmental regulations (Title 22 of the Code of Federal Regulations (CFR), part 216, or Regulation 216). The last PERSUAP that covered economic growth programs (EGP) in Guatemala was written in 2001, and requires updating.

The purpose of this document is to conduct a programmatic Pesticide Evaluation Report (PER) and Safe Use and Action Plan (SUAP) in compliance with 22 CFR 216.3 (b)(1)(i) (a through l). The Pesticide Evaluation Report section addresses the 12 informational elements required in the Agency's Pesticide Procedures. The Safer Use Action Plan puts the conclusions reached in the PER into an action plan that includes assignment of responsibility to appropriate parties connected with the pesticide program.

This analysis covers those pesticides proposed for use by the USAID/Guatemala agriculture development projects that are:

- Registered by US Environmental Protection Agency (EPA) for the same or similar uses without restrictions
- Registered by the Government of Guatemala
- Available in Guatemala and can be included in Integrated Pest Management (IPM) planning

Focus on Integrated Pest Management

The practice of Integrated Pest Management (IPM) is presented in both Section 2.5 of this PERSUAP as well as in the required PER Section 3.3 Factor C analysis. This PERSUAP discusses Good Agricultural Practices (GAP) and IPM tools including commercialized natural pesticides containing Active Ingredients (AIs) extracted from plants, microbes, marine organisms, spices, and minerals as well as cultural practices and synthetic pesticides available in Guatemala and used in the United States.

Annex 1—arguably the most important annex in the PERSUAP—presents all of the crops grown or likely to be grown by projects, all of the major pests and diseases impacting each of these crops, and all of the IPM tactics (including recommended pesticides) that can be used for these specific crop pests and diseases. It presents the GAP/IPM practices used in Guatemala for each crop pest combination anticipated to be found on EGP beneficiary farms, as well as additional GAP/IPM practices used elsewhere for the same pests.

This GAP/IPM/pesticide information is meant to provide EGP implementing partners and beneficiary farmers with a solid starting point for developing their own locally-adapted Pest Management Plans (PMPs) for each crop-pest combination. A guide for developing PMPs is provided in Annex 2. It is expected that the implementing partners will work with farmers and farm managers to prepare PMPs for their clients.

Pesticide Analysis

Because not all of the pesticides that would be used by each project were known at the time this analysis was performed, this PERSUAP analyzes all 287 of the AIs in 3,667 pesticides (natural and synthetic) and other non-fertilizer inputs presently registered and imported into Guatemala as of October 2010. That way, the projects have a first broad sweeping analysis of which AIs are and are not contained in products registered by EPA, so they can make wise future pesticide choices and not use unregistered products. EGP project staff had available on-site, and used, international Maximum Residue Level (MRL) websites and lists to determine allowable levels of specific pesticides on specific crops for consumption and export.

Annex 3 presents all active ingredients (AIs) in pesticides (natural and synthetic) registered, imported to and found in Guatemala. Project decision-makers—especially those who interface at the field level with beneficiary farmers—are encouraged to look at the label of potential pesticide choices to determine the AIs contained in them and use this Annex as a quick reference guide to the attributes and potential hazards of each chemical. It also presents chronic human health issues, water pollution potential, and potential toxicities to important non-target organisms like fish, honeybee pollinators, birds and several aquatic organisms.

Further, Annex 3 contains information on human safety and environmental data needed for the various analyses required throughout the PER; and for project-critical information contained in Annexes 5 and 6. Thus, this PERSUAP provides useful tools for evaluating and choosing among IPM options, including natural and synthetic pesticides, while adhering to 22 CFR 216, as well as aiming at the market-driven best practices found in Standards and Certification (S&C) systems—the highest international standards available.

Finally, Annex 3 provides an analysis of specific pesticides recommended in Annex 1 for use against specific crop-pest combinations, analyzed by each of the 12 Regulation 216 factors (A-L). Specific PERSUAP pesticide recommendations, with AIs also in Spanish, for various crop-pest combinations (see Annexes 1 and 3) include:

acetamiprid (Rescate 20 SP)	malathion (malathion 50 EC)
Agricultural narrow range oil/dormant oil (several products)	mancozeb (Manzate 80 WP)
avermectin (Vertimec 1.8 EC)	methoxyfenozide (Intrepid 24 SC)
azadirachtina (neem oil)	methyl thiophanate (Cycosin 50 SC)
azoxystrobin (Amistar 50 WG)	metsulfuron methyl (Ally 60 WG)
Bacillus thuringiensis (BT kurstaki & aizawai)	*Myrothecium verrucaria* (DiTera DF)
Bacillus thuringiensis (BT) (several products)	oxyfluorfen (Goal 24 EC)
Beauveria bassiana (Naturalis L)	ProMax from Bio Huma Netics (www.humagrow.com)
chlorothalonil (chlorothalonil, Balear 50 SC)	pymetrozine (Pymetrozine 50 WG)
copper hydroxide (Kocide WG)	pyriproxyfen (Knack)
copper sulfate (several products)	soap sprays (potassium salts of fatty acids, several products)
cyproconazole (Alto 100 SL)	spinetoram (Delegate)
cyromazine (Trigard 75 WP)	spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)
dicofol (Mitigan 18 EC)	spiromesifen (Oberon 24 SC)
dimethomorph (Forum 15 EC, Acrobat 50 WP)	sulfur (Sulfur, Thiovit, Kumulus D)
fenbuconazole (Indar 50 OF)	tebufenozide (Mimic 24 SC)
garlic oil (extracto de ajo, several products)	thiamethoxam (Actara 25 WG)
glyphosate (Roundup 36 SL)	thiram (Thiram 50 WP)
imidacloprid (Confidor 35 SC, Plural 20 SI)	*Trichoderma harzianum* (several products)
indoxacarb, S isomer (Avaunt 30 WG)	tryfloxystrobin (Flint 50 WG)
iprodione (Rovral)	

PERSUAP Findings

For compliance with the full intent of Regulation 216, this PERSUAP recommends against the use of:

- Pesticides and Active Ingredients (AI) which are not registered by EPA,
- Pesticide AIs on the Prior Informed Consent (PIC) Convention list,
- Most Restricted Use Pesticides, and
- Most Acute Toxicity Class I Pesticides.

These pesticide AIs are summarized in Annex 5. Implementing partners will need to pair allowed AIs with product names in the Guatemalan Ministry of Agriculture (MAGA)'s master list of registered pesticides, of which each partner should have an updated electronic copy.

This PERSUAP study finds that MAGA continuously registers new pesticide products. However, by comparison with other countries trying to meet international standards, the list of over 3,600 products containing 287 AIs is too long, especially for a ministry with highly limited resources to enforce regulations (Reg 216 Factor J). Of those, 58 contain AIs not registered by EPA (Factor A) in any pesticide product, listed in Annex 5. Products containing any of these 58 AIs should not be used on AID projects.

Farmers choose most pesticides based upon efficacy first and cost second (Factor B). A few products are chosen because they are naturally-derived and acceptable for organic or certified markets. And, most pesticides are applied using backpack sprayers (Factor D), which present safety issues due to the likelyhood of leaks, and require training and maintenance.

Many of the pesticides analyzed and recommended have few chronic human health risks (Factor E), thus those with such risks (potential carcinogen, endocrine disruptor, reproductive or developmental toxin) must be used with safety equipment. All recommended pesticides are considered to be efficacious against listed pests (Factor F), although some pesticide resistance is known and reported for especially synthetic pyrethroids. And, some pose potential ground water pollution risks (Factor H), and should not be used on sandy soils with high water tables.

The recommended pesticides in the crop IPM table (Annex 1) are included as part and parcel of numerous IPM recommendations, thus they all can fit into an IPM program (Factor C). And, most pesticide recommendations include several choices (Factor I) of different types of pesticides, thus alternatives exist.

Almost all pesticides in sufficient quantities—even those extracted from natural sources—have some degree of negative environmental impact (Factor G) including aquatic toxicity (especially to fish), as well as toxicity to honey bees, birds, and earthworms. This includes AIs analyzed and pesticides recommended by this PERSUAP. However, since such risks are identified in Annex 3, project implementers can promote awareness and special spray techniques via training. All of the agriculture projects interviewed exhibited a strong degree of responsibility for training and monitoring (Factors K and L) behavior change with agriculture and pesticides best practices and safe use.

PERSUAP RECOMMENDATIONS

Immediately:

- Ensure that EGP farmers do not use the insecticide endosulfan for treating their crops.
- Ensure that EGP farmers do not use aluminum phosphide to fumigate stored or export food and grain. Fumigation is only to be done by highly-trained spray personnel using specialized canister filter breathing apparatus and phosphine gas meters.

By October 2013:

- Ensure that farmer associations have sufficient personal protective equipment (PPE) available, and assign responsibility for the proper storage and maintenance of this PPE (see PPE recommendations in Annex 10).
- Ensure that each implementing partner has electronic copies of MAGA's most recent Excel spreadsheet of Guatemala-registered pesticides, at all their offices.

Continuously:

- Ensure that farmers use PPE and apply pesticides only during the appropriate times of day.
- Annually test and certify pesticide users on knowledge of human safety and environmental protection.
- Obtain Spanish-language Material Safety Data Sheets (MSDSs) for the most commonly-used commercial pesticides on EGP farms. Keep copies on file at project field staff office sites and farm sites, and use MSDSs for training information on risks and risk reduction.
- Contact MAGA every three months to obtain updated information on new pesticide regulatory changes as well as any new pesticide registrations; keep current lists of MAGA- and EPA-registered pesticides at project sites.
- Assign pesticide commercial product names to AIs analyzed in Annex 3.
- Make copies of the list of pesticide commercial product names that should not be used by beneficiary farmers, and distribute to all project field extension staff and farm managers.
- Ensure that EGP farmers do not use pesticides containing the active ingredients listed in Annex 5.
- Test and promote commercially-available Guatemalan-registered natural chemicals listed in Annex 8.
- Test the crop-pest-specific PMPs (Annex 1) on EGP beneficiary farms to validate and modify use and handling procedures.
- Link with USAID-supported agro-meteorological weather stations for use in predicting pest outbreaks.
- Use PERSUAP PMP information to produce crop-specific reference guides or posters for use by farmers to help identify and manage pests.

- During training, emphasize IPM concepts, methods, and practices (Sections 2.5 and 3.3) that can reduce pesticide use.

- During training, raise awareness of and promote the use of the least toxic synthetic pesticides as well as natural pesticides (Annexes 1, 7 and 8).

- Ensure that annual refresher training cover the following subjects:

    - types and classes of pesticides; human and environmental risk associated with pesticides
    - use and maintenance of PPE (Annex 10)
    - monitoring for the development of pesticide resistance; understanding information on pesticide labels
    - proper collection and disposal of pesticide rinsate and packaging (Annex 14, Agrequima)
    - the importance of keeping children away from the field during and after spraying
    - avoiding using pesticides in or near national parks or headwaters leading to rivers where endangered species are known to exist
    - mitigation measures for reducing risks to environmental resources and biodiversity (PER Sections 3.5, 3.7 & 3.8)
    - ensuring pesticide applicators notify beekeepers about spray activities
    - basic first aid for pesticide poisoning (Annex 12)
    - awareness of pesticides (especially some herbicides) with high ground water contamination potential where water tables are high or easy to reach (Annex 3)

- Invite farm store owners/operators to participate in pesticide safety training.

- For all farms, introduce pesticide record-keeping concepts and tools (Annex 16) used in GlobalGAP or Organic standards.

- Include PERSUAP recommendations and mitigation actions into each grant or sub-contract and in all annual work plans. These documents should include:

    - Identification of outstanding pesticide risk issues
    - Identification of new IPM tactics
    - Identification of farm certification issues
    - Notice of intention to monitor progress of farmers and farm associations in implementing Safe Use Recommendation
    - Other risk mitigation measures to be taken

- Require that project managers keep records on the implementation of the PERSUAP recommendations, including any evidence of pesticide resistance development, and report on the implementation in Annual Reports, under a heading titled "Environmental Mitigation and Monitoring."

- Require project managers to monitor and report on any changes in MAGA's pesticide regulations and product registrations, and resultant changes to the list of pesticides proposed for use by EGP beneficiaries. Should there be any changes, amend the PERSUAP annually and report changes in the Project's Environmental Mitigation & Monitoring Plan (EMMP).

- EGP project staff may consider conducting economic analyses comparing pesticides to determine the most effective choice, taking into consideration health and environmental impact potential.

SECTION 1. INTRODUCTION

1.1 WHY CONDUCT A PERSUAP?

In 1975-76, 2,800 Pakistan malaria spray personnel were poisoned (five fatally) by insecticide mishaps.[1] In response to this and other incidents arising from USAID programs, a law suit was brought by a coalition of environmental groups against USAID for lack of environmental procedures for overseas projects. USAID, in response to the law suit, drafted US 22 CFR 216. This regulation, updated in 1979, now guides most USAID activities that could have potentially negative environmental impacts.

According to 22 CFR 216, all USAID activities are subject to analysis and evaluation via – at minimum – an Initial Environmental Examination (IEE), and – at maximum – an Environmental Assessment (EA). If the proposed activities being funded by USAID include the use of or training in the use of pesticides, a PERSUAP must be included in the IEE.

Pesticides require special attention due to the risks inherent with their use. Part 216.3 of the regulation addresses pesticide use and safety, and requires that consideration be given to 12 pesticide factors, and that recommendations be written to mitigate risks, including the provision of appropriate training and the monitoring of appropriate indicators to determine the success of environmental mitigations. In the early 1990s, USAID adopted the philosophy and practice of Integrated Pest Management as official policy. IPM is strongly promoted and required as part of Regulation 216.3. In addition, since the early 2000s, IPM has been an integral part of GAPs and is increasingly considered to constitute best management practices in agriculture.

In 1972, emphasis shifted away from strict regulation of production and sales of pesticides and toward protecting the environment and public health. In addition to developing best practices for the safe use of pesticides, the law required examining pesticide acute and chronic health risks, ground water contamination, and other environmental impacts. At the international level, to help guide developing countries in which it worked, the United Nations Food and Agriculture Organization (FAO) made a set of easily-adoptable guidelines for import, testing, registration and safe use of pesticides. Over time, most developing countries, including Guatemala, developed similar regulations.

THE PESTICIDE EVALUATION REPORT AND SAFER USE ACTION PLAN

In the late 1990s, USAID's Bureau for Africa developed a tool to analyze the pesticide system in any given country or territory. This "systems approach" analyzes pesticides from import through storage, use, and disposal, and develops a pesticide risk profile based on the analysis. The tool, which is called a ***Pesticide Evaluation Report and Safer Use Action Plan, or PERSUAP,*** is submitted as an amendment to the project IEE or an Environmental Assessment.

This PERSUAP focuses on the particular circumstances of the USAID/Guatemala Economic Growth Program, including the use of pesticides within the EGP projects, the risks inherent in that use, the risk management choices available, and how a risk management plan will be implemented by EGP by those responsible for the execution of the projects.

When the Environmental Protection Agency registers pesticide products for use, it specifies the manner in which the product can be "safely" used (that is, with an acceptably small risk); the allowed uses; best

[1] http://www.ncbi.nlm.nih.gov/pubmed/74508

practices for storage, transport, and disposal; the proper method of application; and the safety equipment needed when applying the pesticide. In many countries, a local-level analysis and evaluation such as a PERSUAP is needed for pesticide use because farmers and other field workers are unlikely to have had sufficient training or literacy levels to effectively reduce the risks associated with using pesticides on their own.

In allowing the use of certain pesticides in its overseas programs, USAID cannot rely on the same societal capabilities and resources that the USEPA does to ensure the appropriate use of the pesticide products in the United States. The preparation of a PERSUAP gives a USAID/EGP project manager the tools for implementing practical actions to reduce the risks of using pesticide products, taking into consideration the context in which the products will be used, the particular elements of the program, and the capacities of the partners and stakeholders involved. Further, the application of PERSUAP recommendations helps prepare project participants to be able to more rapidly adopt GlobalGAP, Organic, and other S&C systems principles.

PERSUAP LINKS WITH ADS 312 ELIGIBILITY OF COMMODITIES

According to ADS 312, "Pesticides are not eligible for financing unless each specific pesticide and the use of the pesticide has received prior approval from USAID in accordance with 22 CFR 216." This provides the technical basis for USAID to make the approval.

1.2 METHODOLOGY

The PERSUAP Consultant was first contacted by IRG in July of 2009, and contracted in September 2009. The Consultant requested USAID/EGP background documents, began internet searches for additional information, and sent requests for needed information to IRG field staff. A systems approach was planned for determining levels of risk throughout the pesticide acquisition, transportation, storage, use and disposal activities contemplated in Guatemala under USAID/EGP projects. All sectors, including civil, public, and private, as well as subsectors (importer/wholesaler to retailer) were investigated, and persons listed in Annex 4 were interviewed. Investigations, observations, and interviews were conducted in the field, identifying risk issues as well as the use of Best Management Practices (BMPs). In the field, particular attention was given to looking and sensing for evidence of pesticide vapors, dusts, and residues.

Projects were asked to provide staff and sites for field visits. It was not logistically possible to visit all field sites of all projects. Further, the team was taken to some "model" fields where most best practices were being followed and the farms were either certified or in the process of gaining certification. The use of BMPs varied from project to project, as did the pesticide risks. For the PERSUAP to serve all projects , the entire pesticide importation sector was analyzed for risks with every active ingredient, and all major pests (invertebrates, diseases and some weeds) of each crop (currently or potential produced with USAID assistance) were identified along with BMPs.

International BMPs including IPM and pesticides that are used in other countries were researched. These GAPs, IPM practices and pesticides are offered to implementing projects as potential tools and tactics to research and potentially adapt or adopt. It is envisioned that both of these databases can be added to and amended as additional decisions on crops and pesticides are made by USAID, the projects and MAGA. Projects will need to research MRLs for the markets they wish to reach.

Following the field visit, the Consultant returned to the United States, analyzed pesticides and crop best practices data and information, and wrote the first draft of this PERSUAP report. It was subsequently reviewed by the Regional Environmental Advisor, whose suggested changes were incorporated into the final version.

SECTION 2. GUATEMALA COUNTRY BACKGROUND

2.1 GUATEMALA COUNTRY AND EGP PROJECTS BACKGROUNDS

Guatemala (República de Guatemala) is a country in Central America bordered by Mexico to the north and west, the Pacific Ocean to the southwest, Belize to the northeast, the Caribbean to the east, and Honduras and El Salvador to the southeast. Its size is slightly smaller than the US state of Tennessee, with 108,889 km², of which 107,159 km² is covered by land and 1,730 km² is covered by water. The distribution of income remains highly unequal with more than half of the population below the national poverty line. Given Guatemala's large expatriate community in the United States, it is the top remittance recipient in Central America, with inflows serving as a primary source of foreign income equivalent to nearly two-thirds of exports. Guatemala is the most populous of the Central American countries with a population of 13,276,517, of which nearly half are rural dwellers employed in agriculture.[2] A sub-set of the 6.6 million rural dwellers are the Guatemala Economic Growth Project's (and this study's) target population.

AGRICULTURE

Of its national territory, only 13.2% of the land is arable, and 5.6% this area is dedicated to permanent crops. Approximately 1,300 km² of land are under irrigated production. Average aggregated fertilizer use is low to moderate by international standards (111.1 kg per ha) due in great part to Guatemala's nutrient-rich volcanic soil). Clearly, more of the arable land could come under production and more of this could come under irrigated production. The agricultural sector accounts for 40% of Guatemalan exports and half of the labor force. Coffee, sugar, and bananas are the primary commercially-produced products, with sugar exports benefiting from increased global demand for ethanol. Although agriculture is the country's major employer, it contributes only 13.1% to the GDP. With the median workforce at about 18 years of age, agricultural training programs have a high probability of positively influencing youth and future progressive farmers to implement GAPs, including IPM and inputs BMPs.

In Guatemala, coffee is produced by two groups of people: small independent farmers and large coffee plantations. Over 90% of Guatemala's coffee is shade grown, and approximately 20% is organic – 40% is certified by one or more organizations. Nearly half of the coffee grown in Guatemala is exported to the United States, much through Starbucks, McDonalds, and other large buyers. Coffee contributes to 4% of GDP and is, according to the National Association of Coffee Producers (Anacafé) cultivated by 1.2-1.5 million people, generating approximately 500,000[3]coffee industry jobs. Other commercially-

[2] https://www.cia.gov/library/publications/the-world-factbook/geos/gt.html

[3] http://www.organicconsumers.org/starbucks/green102004.cfm

produced crops include white maize (milpa), beans, cardamom, and approximately 190,000 metric tons of meat (beef, lamb, pork and chicken). The production of sugarcane, bananas, and cattle for foreign markets is found on large estates on the Pacific piedmont and coastal plain and in the lower Motagua valley. Organic production is focused primarily on coffee, cacao, sesame, bananas, and spices. Spices cultivated in Guatemala include cardamom, vanilla, cinnamon, cloves, nutmeg, anise, coriander, cumin, caraway, fennel, ginger, thyme, saffron, turmeric, curry, chili peppers, and juniper berries.

Since the late 1980s, snow peas have been a major export of Guatemalan farmers. In fact, Guatemala has routinely been able to fill up to 90% of the US market's snow pea demand. Between 1987 and 2002, the snow pea productive area in Guatemala increased by 68% to over 4,000 hectares per year. Snow peas, an introduced crop originating from Central Asia, are sensitive to tropical pests and have been unable to rapidly evolve resistance to these pests. US markets demand unblemished produce, requiring more pesticide applications to pass the stringent standards for cosmetic purposes. These high cosmetic standards have placed greater pressure on growers to use a wide range of pesticides, not only to maintain yields but also to assure the product's appearance.

According to scientists from the Netherlands[4], the Guatemalan snow peas are not green enough, nor do they have sufficient shelf life to sell in Europe. Thus, if any unforeseen delays occur, product value and shipments will be lost. Additionally, European consumers prefer African-grown snow peas, which are perceived to be greener.

Guatemala has approximately 6,000 hectares in mango cultivation, with more than 50% of the production going to export. Of this, 95% of the mango exports go to US markets, with the remaining 5% reaching European markets. New Sanitary and Phytosanitary (SPS) protocols (hot water treatment for Mediterranean Fruit Fly) between MAGA and the United States Department of Agriculture (USDA), Guatemalan mango producers were able to ship mangoes to the USA in 2009.

Over the past 20 years, Guatemala has held trade shows – called AGRITRADE Expo and Conference – to highlight the country's agricultural produce. In 2008, Central American agricultural exports grew 28%, and the region's strategic geographic position, wide range of microclimates and soil types, and productive capacity make it the ideal supplier of a diverse selection of fruits, vegetables, ornamental plants, flowers, foliage, and differentiated products.

REGIONAL TRADE: CAFTA

In 2006 the Central American and Dominican Republic Free Trade Agreement (CAFTA-DR) with the United States came into force significantly liberalizing trade in goods and services. CAFTA-DR includes specific conditions on compliance with customs administration and trade facilitation, reduction of technical barriers to trade, government procurement, investment, telecommunications, electronic commerce, intellectual property rights, transparency, and labor and environmental protection.

CAFTA-DR spurred increased investment in the export sector, but concerns over security, the lack of skilled workers, and poor infrastructure continue to hamper foreign participation. The lack of skilled workers presents particular challenges to the use of GAPs, including the understanding and use of IPM and BMPs for the safe use of pesticides and other agricultural chemicals and inputs. USAID/EGP projects can help to address some of these challenges if they include environmentally sound design in their planning and implementation.

STANDARDS, TESTING, LABELING, AND CERTIFICATION

SANITARY AND PHYTOSANITARY MEASURES

According to US Trade Representative, during the CAFTA-Guatemala negotiations, the governments created an intergovernmental working group to discuss sanitary and phytosanitary barriers to agricultural

trade. As a result of the work of this group, Guatemala has committed to resolving specific measures that may affect US exports to Guatemala. For example, Guatemala now recognizes the equivalence of the US food safety and inspection systems for beef, pork, and poultry, thereby eliminating the need for plant-by-plant inspections of US producers.

Partially due to concerns about and repercussions over the emergence of Bovine Spongiform Encephalopathy in 2003, Guatemala and the other four Central American Parties to the CAFTA-Guatemala notified the World Trade Organization (WTO) of a set of microbiological criteria for all raw and processed food products imported into any of these countries. The United States had concerns with these criteria, and in May 2008 submitted comments to the five countries. The Central American countries are currently evaluating possible amendments to the proposed criteria.

ENVIRONMENT

Guatemala's terrain is mostly mountainous, with narrow coastal plains and rolling limestone plateaus. The climate is hot and humid in the lowlands and cooler in the highlands. These conditions define cropping patterns across the country. Pest problems are considerably more present in the warm lowlands.

Major environmental issues include deforestation in the Petén rainforest and elsewhere that exacerbates, soil erosion and water pollution. Agricultural intensification clearly contributes to the deforestation and therefore requires the use of best practices to conserve and protect valuable resources. Major infectious food- and water-borne diseases include bacterial diarrhea, hepatitis A and typhoid fever, adding these risks to agricultural production.

BIODIVERSITY

According to the International Union for Conservation of Nature (IUCN), Guatemala is considered the fifth-most diverse biodiversity hotspot in the world.[4] The country has 14 eco-regions ranging from mangrove forest (four species of mangrove) on both coasts, dry forests and scrublands in the eastern highlands, subtropical and tropical rainforests, wetlands, cloud forests in the Verapaz region, mixed forests and pine forests in the highlands. Over one-third of Guatemala (36.3% or about 39,380 km^2) is forested (2005). About half of the forests (49.7% or roughly 19,570 km^2) are classified as primary forest, which is considered the most biodiverse forest type. Tree species include 17 conifers (pines, cypress, including the endemic Abies guatemalensis), the most in any tropical region of the world. Guatemala has seven wetlands of international importance that were included in the Ramsar List.[5]

Guatemala has 1,246 known species of amphibians, birds, mammals, and reptiles, according to figures from the World Conservation Monitoring Centre.[6] Of these, 6.7% are endemic and 8.1% are threatened species. Guatemala is also home to at least 8,681 species of vascular plants, of which 13.5% are endemic. About 5.5% of Guatemala is protected under IUCN categories I-V.

With a total of 123 protected areas and more than 29% of the territory declared a protected area, Guatemala has the largest percentage of protected areas in Central America, according to USAID Guatemala's 2003 Biodiversity and Tropical Forestry Assessment. Tikal National Park was the first mixed UNESCO World Heritage Site. The Maya Biosphere Reserve (Petén Department) comprises

[4] http://www.biodiversityhotspots.org/xp/Hotspots/mesoamerica/Pages/default.aspx

[5] http://www.ramsar.org/cda/ramsar/display/main/main.jsp?zn=ramsar&cp=1_4000_0__

[6] http://www.unep-wcmc.org/

2,112,940 ha[7], making it the second largest forest in Central America after Bosawas Biosphere Reserve in Nicaragua.

USAID GUATEMALA ECONOMIC GROWTH PROJECTS BACKGROUND

Assistance Approaches: Economic Growth projects are funded under the Central American and Mexico Strategy Strategic Objective 520-022, which ends in September 2014, and the new Country Development Cooperation Strategy Development Objective 2 Iintermediate Result 1, that covers 2012 to 2016. These projects are slated to receive $128.6 million during the period of 2012 – 2016. Ongoing assistance is provided in an integrated manner covering: (a) policy and regulations; (b) direct technical assistance to rural small and micro-enterprises (SMEs) using the supply chain approach; (c) promoting access to financial services; and (d) environment protection promoting sustainable natural resource management.

Under the above mentioned strategies, USAID Guatemala's projects and activities are the following:

Rural Value Chains Project (RVCP): Under the RVCP the Mission plans to make several cooperative agreement awards to local organizations in order to implement a program that seeks to increase incomes and jobs and reduce malnutrition levels in targeted municipalities of the five departments of the Western Highlands of Guatemala (Huehuetenango, Quiché, San Marcos, Quetzaltenango and Totonicapán) that fall under the Feed the Future Initiative. The objective of this project is to improve household access to food by expanding and diversifying rural income and to contribute to improved nutritional status of families benefitting under this program. This will be accomplished by expanding the participation of poor rural households in productive value chains in horticulture and coffee and linking those chains to local, regional, and international markets in coordination with nutrition behavior change-related activities aimed at improving food utilization and that are implemented by P.L. 480 Title II Food Security Program and health program partners. The program will leverage private sector technical, managerial and financial support for integration of nutrition-related activities into USAID-funded programming and investing in agriculture-related activities such as small-scale infrastructure or packing plants and irrigation systems as an opportunity for job and income generation in the focus areas.

Trade and Investment: USAID supports the development and implementation of laws, regulations, and policies related to rural development, competitiveness and trade, as well as strengthening of public institutions. USAID's assistance includes:

- Rural development: national policy for agricultural research and extension, incorporation of Mellor's model for job generation, and studies on small scale irrigation systems
- Improved competitiveness of SMEs: evaluation of two years of CAFTA-DR implementation, training of customs officials on trade, streamlining of shipment of goods, development of national tourism strategy, and drafting of the market regulations for the telecommunication sector.

Private Sector Competitiveness: USAID/Guatemala supports a number of private-public alliances for producing and processing agricultural products and services that include: mini-vegetables, high value agricultural products, gourmet coffee, forest floral greenery, non-traditional species quality hardwood, handmade ceramics, hand-woven textiles and community eco-tourism. Using a supply chain approach, USAID promotes the use of market certification processes that allow products and services to tap into higher value markets that demand organic, ecologically sustainable production or ecologically friendly tourism. USAID assistance comprises strengthening small producer cooperatives, training in good agricultural practices, management and business skills, and promotes environmental certification and the Green Deal certification seal for tourism services.

[7] http://www.unesco.org/mabdb/br/brdir/directory/biores.asp?code=GUA+01&mode=all

Environment: USAID helps develop policy and regulatory structures to ensure good environment management, as well as technical assistance to strengthen environmental enforcement. USAID also supports sustainable natural resource management in the forestry and community tourism sectors, including the Environmental Services for the Maya Biosphere Reserve Project that facilitates the sale of carbon credits under the reduced emissions from deforestation and degradation (REDD) in the voluntary market.

GUATEMALAN PARTNERS

ANACAFÉ

Anacafé is the national association of Arabica coffee growers. The association supports its members to develop profitable, sustainable and globally competitive agribusinesses.

Anacafé has 50 field technicians that support coffee farmers, and provides water, soil, and leaf quality testing and pest analysis for client farmers, through its laboratory – Analab. In the field, Anacafé also has meteorological stations to collect rainfall, temperature and other data.

FUNDACIÓN AGIL

Fundación Agil is a private nonprofit organization that has, since 2005, been dedicated to improving the lives of rural families and increasing their agricultural productivity and competitiveness. It links small and medium-size producers with high-value markets, using GAPs, Good Manufacturing (Processing) Practice (GMPs), and Good Business Practice (GBPs).[8] Fundación Agil works to transform rural communities into production units that can be integrated into the formal economy, through a process of training, environmental protection, increasing productivity, strengthening competitiveness, and human development. Further, Fundación Agil cooperates with a group of experts in the identification, analysis and development of productive projects, and business and financial services using dynamic methods, where the direct stakeholder participation is essential. It supports local income generation by promoting corporate governance and competitiveness, as well as work with future farmers by integrating its concepts into primary school training.

Fundación Agil has about 2,100 direct beneficiaries in 60 groups of associations or cooperatives (35 farmers/group), as well as about 5,000 indirect beneficiaries. Fundación Agil is putting in place a chain of custody system for produce and meat exports. As USAID funds Fundación Agil, the methodologies and inputs that are used by Fundación Agil's field technicians and beneficiary farmers for training beneficiaries and managing their crop production constraints must follow USAID's environmental regulations. This PERSUAP evaluates Fundación Agil's pest management.

MERCY CORPS

Through the USAID-funded IMARE Project, Mercy Corps works to stimulate, expand, and diversify the rural economy in Guatemala, from traditional farming to high-value market-driven farming. Mercy Corps provides training and technical assistance to small and medium farmer's associations and links them with local Wal-Mart operated supermarket chains (Paiz, Hiper-Paiz, ClubCo, Maxibodega, and Dispensa Familiar) through produce buying agent HortiFruti, and in association with Fundación Agil.

Mercy Corps also helps client farmers to improve vegetable harvesting and post-harvesting practices, and establishes collection and processing centers, including cold chain storage and transport, as well as assisting farmers to access credit.

[8] Crops that are targeted by Fundación Agil include those listed in Annex 1.

AGEXPORT

AgExport (founded in 1982), as its name suggests, provides technical assistance and training to improve food quality and safety with farmers that export fruits and vegetables. Like Mercy Corps, it also supports improved contract farming and access to international markets. In addition to USAID support, AgExport's Business Value Chains Program also receives support from DANIDA and IFAD. AgExport promotes the use of S&C systems such as GlobalGAP and Organic standards.

OTHER PARTNERS

MINISTRY OF AGRICULTURE

The Ministry of Agriculture is responsible for drafting and implementing pesticide regulations and maintaining registries for pesticides, agricultural chemicals, and fertilizers. MAGA drafted new pesticide registration procedures and use regulations on April 1, 2009 (Acuerdo Ministerial No. 127-2009), and presently, over 13,000 agricultural chemicals including pesticides and 2,700 fertilizers/fertilizer combinations are included in the new registry. Of those, about 3,670 pesticides and other agricultural chemicals containing approximately 400 AIs are imported and used. By comparison, Eastern European countries seeking trade opportunities with Western European markets have gotten their lists of registered pesticides down to 300-500 registered pesticide products containing 100-150 AIs.

Presently, as of June 2010, the entire pesticide regulation system is at an impasse in constitutional court as large companies try to challenge the entry of generic pesticides. New laws will likely be written by Congress and/or the President.

PIPAA

The Integrated Program for Agricultural and Environmental Protection (PIPAA) certifies and labels as Guatemalan produce for local supermarket chains. PIPAA is a partner, along with the above projects, in the market value chain that provides consumer quality assurance for consumers.

AGREQUIMA

Founded in 1991, Agrequima is an association of Guatemalan agriculture input (mostly pesticide) producers, importers, and distributers that promotes safe pesticide use. Agrequima is a partner with MAGA and the above USAID-supported initiatives, helping reduce health and environmental risks from pesticides and fertilizers through information dissemination and training. Agrequima represents CropLife International Guatemala, linking farmer cooperatives, academia, and the private sector.

Due to inordinately high pesticide use and risks, Guatemala was chosen by CropLife, along with Thailand and Kenya, for a concerted farmer training program called the Global Safe Use Campaign. Since 1991, over 650,000 people (342,000 farmers; 259,500 students) have been trained. Agrequima also works with and trains health and agro services personnel on pesticide safety issues. Agrequima's initiatives have been noted positively by GlobalGAP, Control Union, Tesco Nature's Choice, and Rainforest Alliance, among others, and in 2005 won a presidential environmental protection medallion.

MINISTRY OF ENVIRONMENT AND NATURAL RESOURCES (MARN)

The Ministry of Environment and Natural Resources, is the lead Guatemalan agency to ensure the country's compliance with the CAFTA-DR agreement, and is collaborating with other Central American environmental ministries to establish a regional policy to manage sources and emissions of high risk chemicals, including pesticides, and developing a regional Contaminant Emission and Transfer Registry.

MINISTRY OF HEALTH

The Ministry of Health (MSPAS), keeps public records of pesticide poisonings and has a certified laboratory for chemical and bacteriological analyses. The United States Department of Interior's Foreign

Agricultural Service (USDA/FAS) has been working on sanitary and phytosanitary trade issues with MAGA and MSPAS to consolidate analytical capabilities, avoid duplication of effort, and save money. MSPAS had the most advanced laboratory capabilities, and has taken the lead in analyzing samples of export produce, pesticides, water, and soil.

US DEPARTMENT OF AGRICULTURE USDA/APHIS

USDA Animal Plant Health Inspection Service (APHIS) ensures that mangoes exported to the United States are treated with hot water to eradicate Mediterranean fruit fly larvae.

USDA/FAS/SPS

USDA/FAS' Regional Sanitary and Phytosanitary Coordinator supports Guatemalan producers and exporters to develop US standards and certification capabilities, as well as to strengthen the capability of Guatemala's diagnostic laboratories. Working in conjunction with the US Trade Representative, the regional SPS Coordinator assists Guatemalan exporter to interpret US regulations and standards regarding food safety and safe pesticide residue levels. The Coordinator brings USG resources such as Plant Protection and Quarantine assistance and EPA officers to Guatemala to train exporters.

INTERNATIONAL TREATIES RELATING TO PESTICIDES

PERSISTENT ORGANIC POLLUTANTS (POPS)

The Stockholm Convention is a global treaty to protect human health and the environment from persistent organic pollutants. POPs are chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms, and are toxic to humans and wildlife. In implementing the Convention, governments take measures to eliminate or reduce the release of POPs into the environment.[9]

PRIOR INFORMED CONSENT

The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, provides all participating countries with detailed information on the risks posed by the chemicals, allowing them to decide whether to accept future imports.[10] If any country does choose to ban or restrict substances on the PIC list, which contains presently 31 chemicals, exporting countries are advised and must immediately inform their exporters, industry and customs departments.

BASEL CONVENTION

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal is the most comprehensive global environmental agreement on hazardous and other wastes. The Convention has 172 Parties and aims to protect human health and the environment against the adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous and other wastes. The Basel Convention came into force in 1992.[11]

MONTREAL PROTOCOL

The Montreal Protocol on Substances That Deplete the Ozone Layer, a protocol to the Vienna Convention for the Protection of the Ozone Layer, is an international treaty designed to protect the ozone layer by phasing out the production of a number of substances believed to be responsible for

[9] Find more details at http://www.pops.int

[10] Find more details at http://www.pic.int.

[11] Find more details at http://www.basel.int/

ozone depletion. For agriculture, the primary substance of concern is the highly toxic pesticide/fumigant methyl bromide, being phased out in the United States and most developed countries. [12]

2.2 USAID/EGP CROPS, MAJOR PESTS, PESTICIDES AND IPM TOOLS AND TECHNIQUES

Annex 1 contains a list of major crops grown by EGP beneficiary farmers, along with primary pest constraints for each. It also contains control practices used by Guatemalan farmers and practices used for the same or very similar pests in the US state of California. This information can be used by implementing partners as a basis for drafting crop-pest-specific PMPs.

What is important in Annex 1 is that it lists favorite pesticides used by Guatemalan farmers, some of which this PERSUAP strongly recommends against. For instance, many farmers still use ***endosulfan*** (an organochlorine pesticide now being phased out by EPA and likely to be banned internationally in the near future) on coffee against coffee cherry borer and onions for thrips. Several RUP chemicals are also used, including insecticides chlorpyriphos, diazinon, methomyl and recently-banned methamidophos, fumigants methyl bromide and metam sodium, nematocide oxamyl, herbicide paraquat, as well as chemicals not EPA registered, like benomyl and iprovalicarb. ***None of these chemicals should be used by EGP beneficiary farmers***. GAP/IPM alternatives are provided in Annex 1.

The crop tables below, albeit redundant with Annex 1, but just like those in the Ecuador PERSUAP, compile all of the crops, major pests, IPM tactics and pesticides likely to be encountered on, and recommended for, EGP projects.

Tables of Crops, Major Pests, Methods of Control and Pesticides

1. Café, Coffee

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Broca del Café, Coffee Berry Borer *Hypothenemus hampei*	• Sanitation – make sure there are no unpicked infested beans left on the trees or laying on the ground. Boil & compost infested cherry. • Use home-made pheromone & alcohol traps, removed 130 days after blooming • Crop pruning and aerating • Pruning of the trees used as natural shade • Use of hyperparasitoids (micro-hymenoptera), if made available, affordable and practical (especially on organic farms).	• *Beauveria bassiana* (Naturalis L)
Ojo de gallo, Cercospora *Cercospora [Mycosphaerella] coffeicola*	• Sanitation – remove and burn or compost old orchard coffee bushes that are infested, not maintained and no longer productive. • Maintain well-fertilized plants with 50% shade cover. • In presence of the disease, the pruning cycles should be shortened to obtain good production.	• copper hydroxide (Kocide WG) • cyproconazole (Alto 100 SL), • azoxystrobin (Amistar 50 WG) • mancozeb (Manzate 80 WP).
Anthracnosis *Colletotrichum*	• Sanitation – remove old orchard coffee bushes that are infested and not maintained. • Shade trees canopy must be thinned.	• azoxystrobin (Amistar 50 WG) • copper hydroxide (Kocide

[12] Find more details at http://www.unep.org/OZONE/pdfs/Montreal-Protocol2000.pdf.

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
gloeosporioides	• Maintain a healthy, pruned plant • Use copper formulations (see above). • Crop pruning and aerating • Pruning of the trees used as natural shade	WG) • cyproconazole (Alto 100 SL), • azoxystrobin (Amistar 50 WG) • mancozeb (Manzate 80 WP)
Phoma *Phoma spp*	• Shade trees canopy must be thinned. • Maintain healthy, pruned plant. • Use copper formulations. • Crop pruning and aerating • Pruning of the trees used as natural shade	• azoxystrobin (Amistar 50 WG) • cyproconazole (Alto 100 SL) • mancozeb (Manzate 80 WP) • copper hydroxide (Kocide WG)
Malezas, Weeds **Various species** **Heavy weed growth competes with coffee plants for soil nutrients**	• At end of the harvest, manual removal of weeds two times a year: first weed control a month before the harvest and the second four months after the first pruning • Small farmers mostly use hand cutting because of the high cost of herbicides and low cost labor availability in the coffee zone.	• glyphosate (Roundup 36 SL) • metsulfuron methyl (Ally 60 WG), • oxyfluorfen (Goal 24 EC)

2. Fresas, Strawberries

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Moho gris (Botrytis), Gray mold *Botrytis cinerea*	• Plastic mulch covertures • Hand pruning of diseased flowers and fruits every week. • Tissue management and cutting that leads to renewal of producing branches.	• copper hydroxide (Kocide WG) • sulfur (Sulfur, Thiovit, Kumulus D) • azoxystrobin (Amistar 50 WG) • mancozeb (Manzate 80 WP)
Root diseases *Phytophthora* spp. *Rhizoctonia* sp.	• Solarization of soil before planting. • Elimination of plant residues from field surface after every growing cycle. • Crop rotation with maize or other crops. • Application of boiling hot water over the planting hole after mulch installation and previous to planting date.	• dimethomorph (Forum 15 EC)
Nematodes Various genera and species	• Use of soil solar sterilization with black plastic.	• ProMax from Bio Huma Netics (www.humagrow.com) • *Myrothecium verrucaria* (DiTera DF)
Tripido de las	• Soil mulches	• Azadirachtine

flores, Western flower thrips *Frankliniella occidentalis*	• Weed control in and around fields • Use of protective covers for green house production • Sampling for thrips by examining early flower clusters Remove weed and crop residue • Use Yellow and blue traps to monitor or for mass trapping • Use of patches of trap crops. • Crop monitoring for thyrips • Use of Biological control by *Orius insidiosus* if available and cost-effective	(Azadirachtina, Neem oil)
Arañita Roja, Twospotted spider mite *Tetranychus urticae* **Arañita, Carmine spider mite** *Tetranychus cinnabarinus*	• Plant density of 6-7 /m2 • Weed control focused on species that act like alternative hosts for mites. • Preplant chilling (vernalization) directly promotes plant vigor. Fall transplant, nursery location, pre-harvest chilling, nursery harvest date, and length of pretransplant supplemental cold storage can all affect a plant's vernalization. • Cultural and biological controls, including releases of predatory mites, and sprays of rosemary oil or organic stylet oil are acceptable for use on organically certified strawberries • Avoid unnecessary spraying and treat only infested portions of the plantation	• spiromesifen (Oberon 24 SC) • dicofol (Mitigan 18 EC) • avermectin (Vertimec 1.8 EC)

3. Moras, Blackberries

Pests/diseases **Plagas/enfermedades**	**Methods of control** **Métodos de control**	**Pesticides** **Plaguicidas**
Trips, **Thrips** Various species	• Remove weed and crop residues. • Use of sticky bright yellow or blue traps for monitoring and mass trapping. • Soil mulches preferring silver-grey or brilliant colors. • Use of a rotational program of insecticides spraying	• imidacloprid (Confidor 35 SC, Plural 20 SI) • thiamethoxam (Actara 25 WG) • spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)
Mildew, **Downey Mildew** *Peronospora sparsa*	• Plastic mulch covering to avoid plant contact with soil and minimize weeds that enhance microclimate conditions favorable to disease dispersion. • Design of good drainage system to avoid soil flooding. • Use sanitation: Weed and crop residues removal to avoid re-infection of new plant tissues and neighboring plants.	• mancozeb (Manzate 80 WP). • dimethomorph (Forum 15 EC)
Moho gris (Botrytis), **Gray mold** *Botrytis cinerea*	• Weekly cleaning pruning and removal of old and diseased flowers or fruits.	• copper hydroxide (Kocide WG) • sulfur (Sulfur, Thiovit, Kumulus D) • mancozeb (Manzate 80 WP) • azoxystrobin (Amistar 50 WG)
Gusanos,	• Use hand control of the green worms when prune or	• azadirachtina (neem oil)

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Green looper worms Scientific names not available	clean old tissues and rotten fruit	• *Bacillus thuringiensis*

4. Lechugas (Romana, amarilla, morada, Salinas), Lettuces (Romaine, green and red leaf, Iceberg)

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Trips, **Thrips** Various species	• Use of sticky yellow or blue traps. • Weed and crop residues removing after harvest. • Increase the density of sticky traps for monitoring and mass trap of adult insects.	• sulfur (Sulfur, Thiovit, Kumulus D) • garlic oil (extracto de ajo, several products)
Afidos, **Aphids** Various species	• Use of sticky yellow or blue traps. Use and increase the density of sticky yellow and blue traps. • Weed management to avoid alternative hosts for aphids. • Avoid the broad spectrum insecticides to minimize natural enemies' destruction.	• Agricultural narrow range oil/dormant oil (several products) • garlic oil (extracto de ajo, several products)
Gusano cogollero, **Armyworm** *Spodoptera exigua*	• Use of early warning monitoring • Use of, minimize the broad spectrum insecticides spraying to enhance the development of natural enemies that include *Trichogramma* species, Braconid wasps and other micro hymenoptera wasps.	• azadirachtina (neem oil) • methoxyfenozide (Intrepid 24 SC) • tebufenozide (Mimic 24 SC) • *Beaveria bassiana* • *Bacillus thuringiensis*
Mosca blanca, **Whitefly** *Bemisia tabaci*	• Use of bright yellow or blue sticky traps for monitoring and control of adult stages. • Integrated crop management includes the host freed periods to conserve natural enemies. • Plant away from other whitefly host crops like cucurbits or tomato. • Use a monitoring program to make the decision for spraying of pesticides. • Use of AgriBon covers will be a choice if it is necessary at least 15 days after planting.	• imidacloprid (Confidor 35 SC, Plural 20 SI) • thiamethoxam (Actara 25 WG) • Spinoace, • Tracer, • Spintor
Minador de la hoja, **Leaf miners** *Lyriomyza species*	• Use of silver plastic mulch with a reflectent color. • Use of sticky yellow or blue traps. • Removal of weeds and crop residues after harvest and the compost of this. • Increase the density of sticky traps, checking every week to keep the sticky effect and monitoring insect populations and mass control for adult stages.	• avermectin (Vertimec 1.8 EC) • cyromazine (Trigard 75 WP) • azadirachtin (azadirachtina (neem oil) • spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)
Mildew velloso **Downy Mildew** *Bremia lactuca*	• Plastic mulch covering to avoid plant contact with soil and minimize weeds that enhance microclimate conditions favorable to disease dispersion. • Design of good drainage system to avoid soil flooding. • Weed and crop residues removal to avoid re-infection over new tissues and neighbor plants. • Sanitation-remove dead plants to minimize inoculum and reinfection of area.	• mancozeb (Manzate 80 WP) • dimethomorph (Forum 15 EC)

5. Cruciferae, Crucifers, Cole crops: Brocoli, Broccoli; Repollo, Cabbage; Coliflor, Cauliflower

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Plutella Diamond-back moth *Plutella xylostella*	• For monitoring, use light traps over soap dish to control adult stages and monitoring insect population's dynamics. • Sticky bright yellow or blue traps will help to trap and control adult stages. • Use of biological control with Trichogramma spp., and other microhymenoptera wasps	• azadirachtina (neem oil) • *Beauveria bassiana* (Naturalis L) • Bacillus thuringiensis
Mariposa blanca Imported Cabbage Worm *Artogeia rapae*	• The recommendations will be the same as those given for *Plutella* control, above.	• azadirachtina (neem oil) • *Beauveria bassiana* (Naturalis L) • Bacillus thuringiensis
Hernia de la col Cole crops root club *Plasmodiophora brassicae* This is a very destructive disease of cole crops. Infected fields will be destroyed to 100% when the plant infection starts at early stages.	• Crop rotation. • proper handling of transplants and irrigation water • Use of certified healthy plants to avoid diseases spreading. • Infected plants must be extracted and burned out of agricultural fields. • Dolomitic calcium or gypsum must be used at least once per year to raise pH.	• None

6. Cebollas dulces blancas y amarillos, White and yellow onions

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Trips, Thrips **Various species**	• Use of sticky yellow or blue traps • Sanitation-remove weed and crop residues after harvest. • Increase the density of sticky traps for monitoring and mass trap of adult insects.	• sulfur (Sulfur, Thiovit, Kumulus D) • garlic oil (extracto de ajo, several products)
Gusano cortador, Cutworm *Agrotis subterranea*	• Good soil preparation • Weed control	• azadirachtina (neem oil) • *Beauveria bassiana* (Naturalis L) • Bacillus thuringiensis
Gusano cogollero, Armyworm *Spodoptera exigua*	• Good soil preparation • Weed control	• *Beauveria bassiana* (Naturalis L) • Bacillus thuringiensis
Botrytis wilt *Botrytis alli*	• Sanitation—remove diseased onions, clean and disinfect all harvest equipment • Good drainage and crop rotation after 2 years	• mancozeb (Manzate 80 WP) • chlorotalonil

Fusarium *Fusarium* sp.	• Farmers use resistant varieties • Soil disinfection with organic mulch and soil amendments that increase humic acid content	• *Trichoderma harzianum (several products)* • mancozeb (Manzate 80 WP) • chlorothalonil (chlorothalonil, Balear 50 SC)
Mildiu Algodonoso/ Mildiu Lanoso, Downy Mildew *Peronospora destructor*	• Crop rotation • Use certified seed and good drainage • Plastic mulch covering to avoid plant contact with soil and minimize weeds that enhance microclimate conditions favorable to disease dispersion. • Heat treatment of bulbs at 35, 40 °C for 4 to 8h reduce the disease significantly. • Eliminate residue, plant during dry season, avoid irrigation during heat of the day	• *mancozeb (Manzate 80 WP)* • *copper hydroxide (Kocide WG)* • *chlorothalonil (chlorothalonil, Balear 50 SC)* • *dimethomorph (FORUM 15 EC)*
Raiz Rosada, Pink Root **Pyrenochaeta terrestres**	• Crop rotation • Soil solarization	
Pythium *Pythium spp.*	• Water regulation must be a good agricultural practice, then use drip irrigation.	• *chlorothalonil (chlorothalonil, Balear 50 SC)*
Sclerotium Southern blight **Sclerotium rolfsii**	• Promotion of antagonist fungi in the soil by use of compost	• *mancozeb (Manzate 80 WP)*
Alternaria *Alternaria porri*	• Sanitation, clean up crop residues, burn.	• *chlorothalonil (chlorothalonil, Balear 50 SC, as seedling dip)* • *mancozeb (Manzate 80 WP)* • *azoxystrobin (Amistar 50 WG)*
Malezas Weeds	• Use soil mulches and pruning. • Hand/hoe weeding • Use drip irrigation to regulate water in the crop and avoid weed emergence.	• *oxyfluorfen (Goal 24 EC)*
Minador de la hoja, Leaf miners *Lyriomyza spp*	• Use of plastic mulch, silver grey will be the better option, because of his repellent effect. • Removal and compost of weeds and crop residues after harvest and the. • Use of sticky yellow or blue traps. Increase the density of sticky traps, checking every week to keep the sticker effect and monitoring insect populations and mass control for adult stages.	• *spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)* • *cyromazine (Trigard 75 WP)*

7. Apio, Celery

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Mosca blanca, White flies *Bemisia tabaci*	• Crop rotation • Destroy weeds and host crops. • Crop monitoring is important; the farmer inspects the entire area in the field to locate the presence of pests. • Whiteflies can also be monitored using bright yellow sticky traps. • Learn to anticipate and prevent problems; reduce plant stress. Use virus-free and whitefly-free transplants. • Use crop rotation. • During non-planting periods conserve natural enemies.	• *Trichoderma harzianum (several products)* • Actara (Thiamethoxam) • pymetrozine (Pymetrozine 50 WG)
Trips, Flower thrips *Frankliniella occidentalis*	• Use blue sticky traps • Crop monitoring • Transplanting health plants. • Use pesticides only when it necessary. • Destroy weeds and host crops. • Clean and disinfecting the greenhouse from plants the debris from previous crops. • Humidity (RH), temperature control	• thiamethoxam (Actara 25 WG) • spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC) • *Beauveria bassiana* (Naturalis L) • avermectin (Vertimec 1.8 EC) • Azadirachtina (neem oil) extract • Acetamiprid (Rescate 20 SP) • imidacloprid (Confidor 35 SC, Plural 20 SI)
Acaro rojo, Red spider mites *Tetranychus spp.*	• Crop monitoring	• avermectin (Vertimec 1.8 EC)

8. Cucurbits: Zucchini, calabaza, calabacitas, squashes, pumpkin

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Mosca blanca, White fly *Bemisia tabaci*	• Use of sticky bright yellow or blue traps for monitoring and adult stages control. • Remove and burn crop residues and weeds. • Weed removal, specially Solanaceae and Malvaceae family species that will be alternative hosts of this insect. • Use of AgriBon cover at early stage of seedlings, about 20 days. • Host free periods conserve natural enemies. • Plant away other whitefly host crops like tomato, pepper bell and other cucurbits.	• garlic oil (extracto de ajo, several products) • Agricultural narrow range oil/dormant oil (several products) • imidacloprid (Confidor 35 SC, Plural 20 SI) • thiamethoxam (Actara 25 WG) • spinoace (Tracer, Spintor), • pymetrozine (Pymetrozine 50 WG) • *Trichoderma harzianum (several products)*

Minador de la hoya, Leaf miners *Lyriomyza species*	• Use of plastic mulch with a reflectent color. • Use of sticky yellow or blue traps. • Weed and crop residues removal and burning after harvest. • Use of plastic silver gray mulch with repellent properties.	• garlic oil (extracto de ajo, several products) • Agricultural narrow range oil/dormant oil (several products) • imidacloprid (Confidor 35 SC, Plural 20 SI) • thiamethoxam (Actara 25 WG) • spinoace

9. Arveja china, Arveja dulce, Snow peas, Sugar snaps

Pests/diseases **Plagas/enfermedades**	**Methods of control** **Métodos de control**	**Pesticides** **Plaguicidas**
Minador de la hoja, Leaf miners *Lyriomyza species*	• Weed and crop residues removal after harvest. • Crop rotation with corn, onions or other species not related with snow peas. • Use of plastic mulch with a reflectent color, silver grey will be one of the more effectives. • Use of yellow or blue sticky traps.	• imidacloprid (Confidor 35 SC, Plural 20 SI) • acetamiprid (Rescate 20 SP) • spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC) • cyromazine (Trigard 75 WP)
Mancha de la vaina Black spot of pod *Ascochita* spp.	• Strings must be hung on time to hold up the new foliage so that it does not hang over the pods and flowers, creating excessive humidity favorable to spreading this disease. • Regulation of Nitrogen fertilizers at pod production time (the increase of this element will produce more foliage which is favorable for the disease development).	• copper hydroxide (Kocide WG) • copper sulfate (several products) • sulfur (Sulfur, Thiovit, Kumulus D) • mancozeb (Manzate 80 WP) • azoxystrobin (Amistar 50 WG) • tryfloxystrobin (Flint), • chlorotalonil (Daconil)
Trips, Thrips *Frankiniella spp.*	• Use of plastic mulch with a reflectent color. • Use of sticky yellow or blue traps for monitoring and mass trapping. • Weed and crop residues removing after harvest and compost or burn it.	• garlic oil (extracto de ajo, several products) • Agricultural narrow range oil/dormant oil (several products) • imidacloprid (Confidor 35 SC, Plural 20 SI) • thiametoxam, • spinoace

10. Ejote Frances, green beans, Habas, faba beans

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Trips, **Thrips** *Thrips tabaci*	• Soil mulches • Field sanitation • Crop rotation • Apply agricultural oil between each application of other chemicals. • Keep production areas free of weeds, which can serve as hosts for thrips populations. • Monitor and trap flower thrips using blue sticky cards. • Most insecticides must be applied at least two times, 5 to 7 days apart, for efficacy against thrips.	• *Beauveria bassiana* (Naturalis L) • avermectin (Vertimec 1.8 EC) • Azadirachtina (neem oil) extract, • Acetamiprid (Rescate 20 SP), • imidacloprid (Confidor 35 SC, Plural 20 SI) • spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)
Pulgones, **Aphids** *Aphis* spp. *Myzus* spp.	• Use of yellow or blue sticky traps. • Crop rotation. • Use of natural barriers with corn or sorghum. • Use of predators such as green lacewing larvae, lady beetles, and syrphid fly larvae prey on this aphid as well as on other aphid species. • Sanitation is important in curbing the spread of the viruses that this insect vectors. Discard all crop residues (compost or plow/disc under) as soon as harvest is complete.	• soap sprays (potassium salts of fatty acids, several products) • imidacloprid (Confidor 35 SC, Plural 20 SI) • spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC) • acetamiprid (Rescate 20 SP) • pymetrozine (Pymetrozine 50 WG)
Bacteriosis **Bacterial soft rot** *Erwinia sp.*	• Good nutritional program to promote resistance once the disease appears on the field • Planting on raise bed. • Planting on raised beds in poorly drained areas may also reduce bacterial infections. • Careful harvest handling, grading and sanitation (clean harvest tools) are the only ways to reduce the problem.	• copper hydroxide (Kocide WG)
Alternaria, **Black rot** *Alternaria spp.*	• Since the fungus can survive in the seed, hot water treatment of seed at 50°C for 15 minutes is recommended. • Crop rotation and destruction of infected plant material in the field will minimize the disease infection.	• iprodione (Rovral) • azoxystrobin (Amistar 50 WG) • mancozeb (Manzate 80 WP) • chlorothalonil (chlorothalonil, Balear 50 SC) • thiram (Thiram 50 WP, as seed treatment)

Nematodos, Nematodes Various genera	• Soil sampling and testing previous planting. • Crop rotation with potatoes, lettuce, garlic or other crops on the area. • If a previous crop had problems caused by nematodes that are also listed as pests of Cole crops, population levels may be high enough to cause damage to subsequent crops. • The use of pest-free transplants • Transplants should be produced in sterile growing medium or in soil that has been fumigated. • Use of calcic cianamide to disinfect soil 25 days before seeding. • Sanitation: (1) Thoroughly clean all equipment with water to prevent the spread of the nematodes. (2) Do not allow irrigation water to flow from an infested field to other fields without impounding. (3) Prevent animal grazing and movement from infested to uninfested fields. • Cultural practices. Plow under infested plants after harvest to prevent further reproduction of nematodes. Reduce stress on plants by proper fertilization and irrigation.	• ProMax from Bio Huma Netics (www.humagrow.com) • Myrothecium verrucaria (DiTera DF)
Aphidos caupí, Cowpea aphid *Aphis craccivora*	• Use regular monitoring with yellow sticky traps • Use resistant varieties • Use sanitation • Many predators and parasites attack aphids, especially in fields that are not sprayed or sprayed with less toxic materials. • Remove infested culls and weedy species around fields that may harbor the aphid between crops.	• Agricultural narrow range oil/dormant oil (several products) • acetamiprid (Rescate 20 SP), • pymetrozine (Pymetrozine 50 WG) • malathion (Malathion 50 EC) • thiamethoxam (Actara 25 WG) • imidacloprid (Confidor 35 SC, Plural 20 SI) • soap sprays (potassium salts of fatty acids, several products)
Mosca blanca, White fly *Bemisia tabaci*	• Crop rotation • Destroy weeds and host crops. • Crop monitoring. • In addition to causing direct damage to the plant, whitefly is a vector of viruses. • Whitefly can be monitored using bright yellow sticky traps. • Integrated crop management. • Plant away from other whitefly host plants like cucurbits. • Use pesticides only when it necessary after a monitoring program.	• thiamethoxam (Actara 25 WG) • pymetrozine (Pymetrozine 50 WG) • Trichoderma harzianum (several products) • imidacloprid (Confidor 35 SC, Plural 20 SI) • Actara (Thiametoxam)

Marchitez/mal del talluelo, Damping off diseases: **Pythium root rot,** *Pythium spp* **Phytophthora root rot,** *Phytophthora spp*	• Use regular monitoring, • Use resistant varieties • Use sanitation • Provide adequate field drainage and prevent excessive seepage from irrigation canals. Most importantly avoid over-irrigating, especially during periods of high temperatures. • In soils where drainage is a problem, plant in raised beds, use sprinkler irrigation • Rotate to non-susceptible crops to reduce Inoculum potential. Carefully adjust cultivating and thinning equipment to reduce mechanical injury to feeder roots.	• thiram (Thiram 50 WP) • mancozeb (Manzate 80 WP) • copper hydroxide (Kocide WG)
Fusariosis Fusarium rot *Fusarium spp*	• Use monitoring • Use resistant varieties • use methods that favor rapid seedling emergence, including planting seeds as shallowly as practical and managing soil moisture (pre-plant irrigate, seed into moist soil and delay second irrigation until seedlings are beyond susceptible stages). • Buy seeds treated with protective fungicides that are effective against the pathogens in the soil to be planted.	• mancozeb (Manzate 80 WP) • iprodione (Rovral) • tryfloxystrobin (Flint 50 WG)
Gusanos cortadores, Cutworms *Agrotis sp.*	• Use regular monitoring • Use sanitation • Cutworms have numerous natural enemies, but none can be relied on to bring a damaging population down below economic levels. • Remove weeds from field margins and plow fields at least 10 days before planting to destroy larvae, food sources, and egg-laying sites. • After the crop is up, check for a row of four or more wilted plants with completely or partially severed stems. If you find damaged plants, look for cutworms by digging around the base of plants and sifting the soil for caterpillars.	• imidacloprid (Confidor 35 SC, Plural 20 SI) • indoxacarb, S isomer (Avaunt 30 WG) • Bacillus thuringiensis (BT) kurstaki & aizawai • spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)
Mancha foliar, Leaf spot *Cercospora spp*	• Use monitoring • Use resistant varieties • Provide adequate field drainage and prevent excessive seepage from irrigation canals. Most importantly avoid over-irrigating, especially during periods of high temperatures. • In soils where drainage is a problem, plant in raised beds, use sprinkler irrigation, and rotate to non-susceptible crops to reduce inoculum potential. • Carefully adjust cultivating and thinning equipment to reduce mechanical injury to feeder roots.	• mancozeb (Manzate 80 WP) • copper hydroxide (Kocide WG) • iprodione (Rovral) • tryfloxystrobin (Flint 50 WG)
Gallina ciega, White grub *Phyllophaga spp.* **Gusano alambre, Wireworm**	• Till soil a week before planting, to expose larvae to predatory birds. • Use light traps when large densities of the adult stage appear. • Use compost and manure.	

Agriotes spp.		

11. Zanahorias, Carrots

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Tizón de la zanahoria, Carrot leaf wilt *Alternaria dauci*	• Crop residue and weed removal after harvest will reduce inoculums for next crop cycle. • Use adequate planting densities to avoid excessive moisture in crop foliage. • Use resistant varieties	• mancozeb (Manzate 80 WP) • copper hydroxide (Kocide WG) • chlorothalonil (chlorothalonil, Balear 50 SC) • azoxystrobin (Amistar 50 WG)
Nematodos, Nematodes *Various genera*	• Soil sampling before to make decisions about if the field is adequate to grow carrots. • Soil solarization.	• ProMax from Bio Huma Netics (www.humagrow.com) • *Myrothecium verrucaria* (DiTera DF)

12. Papaya

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Papaya fruit fly, Mosca de la papaya *Toxotrypana curvicauda*	• Weed control in and around the crop field. • Ripe fruit is collected from field in plastic bags and managed to avoid an infestation. • Preventing egg-laying either by mechanical means or by applying insecticides to kill the adult female before she deposits her eggs. • Use of paper bags. Bagging should begin when the fruit is small, shortly after the flower parts have fallen. This method of control is more adapted to small (1 to 25 plants) than to large (one-fourth acre or more) plantings. • Destroy all dropped and prematurely ripe fruit, as well as small fruit suspected of being infested to prevent the larvae from developing into adult fruit flies.	• None
Afidos/chicharrita, Aphids/Leafhopper Cowpea aphid, *Aphis craccivora* Cotton aphid, *Aphis gossypii* Green peach aphid,	• Use regular monitoring, yellow sticky traps • Use resistant varieties • Use sanitation • When populations are heavy, aphids can stunt seedlings; however, economic damage rarely occurs on older plants. • Many predators and parasites attack aphids, especially in fields that are not sprayed or sprayed with less toxic materials. • Remove infested culls and weedy species around fields	• Agricultural narrow range oil/dormant oil (several products) • acetamiprid (Rescate 20 SP), • pymetrozine (Pymetrozine 50 WG) • malathion (Malathion 50 EC) • thiamethoxam (Actara 25 WG) • imidacloprid (Confidor 35

Myzus persicae Papaya leafhopper *Empoasca papaya*	that may harbor the aphid between crops.	SC, Plural 20 SI)
Cochinilla de papaya, **Papaya mealybug** *Paracoccus marginatus*	• Use regular monitoring, yellow sticky traps • Use sanitation • Can use orchard design, trap cropping and border trapping using sections of 'sacrifice' papaya trees with pheromone traps for control. • Sanitation by collection and destruction of infested fruits prior to adult emergence from fruits. • Protein bait sprays with spinosad may become available.	• Beauveria bassiana (Naturalis L) • soap sprays (potassium salts of fatty acids, several products) • spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC, and in protein baits)

13. Citricos: Limon persa, Limon criollo, Naranja dulce, Lemons and Oranges

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Acaros, **Spider mites** *Tetranychus spp.*	• Use regular monitoring • Use sanitation • Spider mites have many natural enemies that often limit populations. Broad-spectrum insecticide treatments for other pests frequently cause mite outbreaks, so avoid these when possible. • Adequate irrigation is important because water-stressed plants are most likely to be damaged. • Predator mites commercially available for purchase and release are the western predatory mite and *Phytoseiulus.* • Control dust: Apply water to pathways and other dusty areas at regular intervals.	• soap sprays (potassium salts of fatty acids, several products) • Agricultural narrow range oil/dormant oil (several products) • avermectin (Vertimec 1.8 EC)
Tripido Banda roja **Red banded thrips** *Selenothrips rubrocinctus*	• Use of natural enemies such as minute pirate bugs, lacewing or predatory thrips.	• Agricultural narrow range oil/dormant oil (several products products)plus any of the following: • sabadilla (Veratran D) • spinetoram (Delegate) • spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC) • avermectin (Vertimec 1.8 EC) (Vertimec)

14. Mango

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Mosca del Mediterraneo, **Mediterranean fruit**	• USDA-APHIS and MAGA-PIPAA, are developing a monitoring and fruit pre-inspection program for mango exporters in order to avoid the fruit fly dispersion to	• Agricultural narrow range oil/dormant oil (several products)

fly *Ceratitis capitata*	northern countries. • Monitoring program • Canopy management • Biological control by parasitic wasps	• malathion (Malathion 50 EC)
Hormigas, Ants *Solenopsis spp.*	• Ants are not controlled for in most orchards • Sanitation, clean out nests • paint tree trunks white	• None
Cenicilla del mango Powdery Mildew *Oidium mangiferai*	• Daily monitoring, if 2 infected flowers per plant, apply sulfur and follow the recommendations for antracnosis (below) •	• sulfur (Sulfur, Thiovit, Kumulus D) • cyproconazole (Alto 100 SL) • fenbuconazole (Indar 50 OF)
Antracnosis, Anthracnoses *Colletotrichum gloeosporoides*	• Removal of fallen and leftover mangoes and fallen leaves • Pruning to promote ventilation	• mancozeb (Manzate 80 WP) • copper hydroxide (Kocide WG) • cyproconazole (Alto 100 SL)

15. Rambután, Litchi

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Hiedevivo Green stink bug (GSB) *Nezara viridula*	• Use resistant varieties • Many parasitoids control GSB eggs and larvae, so do not use broad-spectrum insecticides; monitor for parasitism levels and make treatment decision accordingly • Destroy weeds (legumes, thistles, mustards, and mallows) that are good overwintering hosts for adult stink bugs around fields • A pheromone lure developed in Australia may work on GSB	• thiamethoxam (Actara 25 WG) • imidacloprid (Confidor 35 SC, Plural 20 SI) • kaolin clay (several products) • soap sprays (potassium salts of fatty acids, several products)
Trips, Flower thrips *Frankiniela occidentalis*	• Use resistant varieties. • Correctly identify the problem; if insect or disease, learn the life cycle and habits. • Learn to anticipate and prevent problems; reduce plant stress. • Do crop rotation. • Adult thrips can also be monitored using bright blue sticky traps.	• thiamethoxam (Actara 25 WG) • *Trichoderma harzianum (several products)* • *Beauveria bassiana* (Naturalis L) • avermectin (Vertimec 1.8 EC), • Azadirachtina (neem oil) extract, • Acetamiprid (Rescate 20 SP), • imidacloprid (Confidor 35 SC, Plural 20 SI) • spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)

Afidos, Aphids *Myzus persicae*	• Use of yellow or blue sticky traps. • Crop rotation, plant away from other hosts. • Integrated crop management. • Crop monitoring before spraying. • Host free periods conserve natural enemies. • Use pesticides only when it necessary after a monitoring program. • Destroy weeds and host crops as soon as possible, including the head rows.	• garlic oil (extracto de ajo, several products) • Agricultural narrow range oil/dormant oil (several products) • imidacloprid (Confidor 35 SC, Plural 20 SI) • acetamiprid (Rescate 20 SP) • pymetrozine (Pymetrozine 50 WG)
Pudricion radicular y de tallo por phytophthora, Phytophthora Blight *Phytophthora cryptogea*	• Use of resistant varieties. • Use raised-bed. • Crop monitoring is important; the farmer inspects the entire area in the field to locate the presence of blight. • Planting sites should be well drained and free of low-lying areas. • The drainage area of the field should be kept free of weeds and volunteer crop plants. • Cleaning and disinfecting machinery and tools. Flats, plug trays, benches, seeding equipment, and plant house structures should be disinfected using a sodium hypochlorite solution or other disinfectant.	• iprodione (Rovral) • azoxystrobin (Amistar 50 WG) • chlorothalonil (chlorothalonil, Balear 50 SC) • copper hydroxide (Kocide WG) • methyl thiophanate (Cycosin 50 SC) • tryfloxystrobin (Flint 50 WG)

16. Esparragos, Asparagus

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Pudrición de corona Asparagus crown rot *Pythium sp.* *Phytophthora sp.*	• Plant in well drained soils, avoid flooding. • Water regulation must be an aid to avoid disease. • Crop rotation with corn. • Use of fungicides must be rotational.	• chlorothalonil (chlorothalonil, Balear 50 SC) • methyl thiophanate (Cycosin 50 SC)

17. Okras China & Tailandesa, Okras, Chinese & Thai

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Mosca blanca, Wihite fly *Bemisia tabaci*	• Use of sticky blue or yellow traps. • Weed control in and around the field crop. • Crop rotation with corn or sorghum. • Crop residues must be eliminated from field. • Use of barriers made with corn or sorghum. • Agribon plant tunnels or covers must be applied to avoid the insect in first 20 days. • Increase the sticky traps density.	• Agricultural narrow range oil/dormant oil (several products) • soap sprays (potassium salts of fatty acids, several products) • imidacloprid (Confidor 35 SC, Plural 20 SI) • acetamiprid (Rescate 20 SP) (Rescate 20 SP)

		• pyriproxyfen (Knack)

18. Berenjenas: China, Indu, Tailandesa, Eggplants: Chinese, Indian, Thai

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Mosca blanca, White fly *Bemisia tabaci*	• Use of sticky blue or yellow traps • Weed control in and around the field crop. • Crop rotation with corn or sorghum. • Crop residues must be eliminated from field. • Use of barriers made with corn or sorghum. • Agribon plant tunnels or covers must be applied to avoid the insect in first 20 days. • Increase the sticky traps density.	• Agricultural narrow range oil/dormant oil (several products) • soap sprays (potassium salts of fatty acids, several products) • imidacloprid (Confidor 35 SC, Plural 20 SI) • acetamiprid (Rescate 20 SP) (Rescate 20 SP) • pyriproxyfen (Knack)
Alternariosis, Alternaria black spot *Alternaria solani*	• Use resistant varieties. • Use crop rotation with other non solanaceous crops. • Weed and crop residues must be done before planting.	• mancozeb (Manzate 80 WP)

19. Solanaceous Crops Tomate/Tomato, Papa/Potato

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Only on Tomato: Gusano del Cuerno del Tomate, Tomato Hornworm *Manduca spp.* & **Fruitworm del Tomate, Tomato Fruitworm** *Heliothis (Helicoverpa) zea*	• Monitor crop regularly for evidence of horn worm • In smaller plots, hand-pick horn worm caterpillars	• *Bacillus thuringiensis* (BT) • imidacloprid (Confidor 35 SC, Plural 20 SI) • thiamethoxam (Actara 25 WG)
Mosca blanca, whitefly (virus vector) *Bemesia tabaci*	• Farmers use yellow and green sticky traps to monitor and reduce populations • Use resistant varieties Use Agribon macro and microtunnels	• *Beauveria bassiana* (Naturalis L) • thiamethoxam (Actara 25 WG) • imidacloprid (Confidor 35 SC, Plural 20 SI)
Minador de la hoja, Leaf miners *Lyriomyza spp.*	• Farmers use yellow and green sticky traps to monitor and reduce populations • Use Agribon macro and microtunnels • To avoid resistance, alternate pyrethroids with neonicotinoid insecticides	• thiamethoxam (Actara 25 WG) • imidacloprid (Confidor 35 SC, Plural 20 SI) • spinosad (Tracer 48 SC,

		Spintor 12 SC, Spinoace 12 SC) • cyromazine (Trigard 75 WP)
Tizón Tardio, Late Blight *Phytophthora infestans*	• Use tolerant varieties and raised-bed production • Farmers use sticks and lines (tutorado) to raise plants and fruit into the air to aerate the plant and raise the leaves and fruit away from the soil • Drain the growing field adequately before planting • Follow proper planting date; do not plant late	• dimethomorph (Forum 15 EC, Acrobat 50 WP) • mancozeb (Manzate 80 WP) • chlorothalonil (chlorothalonil, Balear 50 SC)
Tizón Temprano, Early Blight *Alternaria solani*	• Use of tolerant varieties • Use of raised-bed planting system • Farmers use sticks and lines (tutorado) to raise plants and fruit into the air to aerate the plant and raise the leaves and fruit away from the soil	• copper sulfate (several products) • chlorothalonil (chlorothalonil, Balear 50 SC) • azoxystrobin (Amistar 50 WG), • tryfloxystrobin (Flint 50 WG)
Tizón Bacterial, Bacteriosis, Bacterial blights *Xanthomonas spp.* *Pseudomonas spp.*	• Use raised-bed production and monitor soil moisture • Sufficiently drain the growing field • Monitor the field frequently and remove dead and dying plants that are full of innoculum	• copper hydroxide (Kocide WG) • mancozeb (Manzate 80 WP)
Tizón por Fusarium, Fusarium blight *Fusarium oxysporum*	• Use tolerant varieties and raised-bed production • Sufficiently drain the growing field and monitor soil moisture • Farmers use sticks and lines (tutorado) to raise plants and fruit into the air to airate the plant and raise the leaves and fruit away from the soil	• dimethomorph (Forum 15 EC, Acrobat 50 WP) • copper sulfate (several products) • mancozeb (Manzate 80 WP) • chlorothalonil (chlorothalonil, Balear 50 SC)

20. Melocotón, Peaches

Pests/diseases Plagas/enfermedades	Methods of control Métodos de control	Pesticides Plaguicidas
Rona del melocotón Apple scab/black spot *Venturia inaequalis*	• Use resistant varieties. • Use adequate plant densities. • Make the tissue management (pruning) at the correct time.	• copper hydroxide (Kocide WG) • chlorothalonil (chlorothalonil, Balear 50 SC) • azoxystrobin (Amistar 50 WG)

Moho gris, **Gray mold** *Botrytis cinerea*	• A weekly pruning for removal of old and rotten flowers or fruits must be done. •	• copper hydroxide (Kocide WG) • sulfur (Sulfur, Thiovit, Kumulus D) • mancozeb (Manzate 80 WP) • azoxystrobin (Amistar 50 WG)
Trips, **Flower thrips** *Frankiniela occidentalis*	• Learn to anticipate and prevent problems; reduce plant stress. • Adult thrips can also be monitored using bright blue sticky traps	• thiamethoxam (Actara 25 WG) • Trichoderma harzianum (several products) • Beauveria bassiana (Naturalis L) • avermectin (Vertimec 1.8 EC), • Azadirachtina (neem oil) extract, • Acetamiprid (Rescate 20 SP), • imidacloprid (Confidor 35 SC, Plural 20 SI) • soap sprays (potassium salts of fatty acids, several products) • avermectin (Vertimec 1.8 EC) • spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)
Afidos, **Aphids** *Myzus persicae*	• Use of yellow or blue sticky traps. • Integrated crop management. • Crop monitoring before spraying. • Host free periods conserve natural enemies. • Use pesticides only when it necessary after a monitoring program. • Plant away the hosts. • Destroy weeds and host crops as soon as possible, including the head rows.	• imidacloprid (Confidor 35 SC, Plural 20 SI) • acetamiprid (Rescate 20 SP) • pymetrozine (Pymetrozine 50 WG)

2.3 BEST PRACTICES FOR RESOURCE CONSERVATION FOR PRODUCING USAID/EGP CROPS

Each crop produced by USAID/Guatemala EGP beneficiary farmers/processors affects natural resources and biodiversity during production, harvest, processing, packaging and/or transportation. These impacts on the natural resource base are influenced by topography, soil type, water sources, climate, access and affordability of technology, new information and knowledge. S&C systems address these impacts via GAPs and GMPs, which incorporate cleaner production and pollution prevention (CP3) concepts, biodiversity and natural resource conservation, and even carbon footprint minimization.

RESOURCES TO CONSERVE

Production resources for agriculture include: natural resources such as soil, water, biodiversity, tropical forests, chemical inputs for the production of fertilizers and pesticides, and recyclable man-made materials such as plastics, metals, glasses, paper, and cardboards. Best management practice conserving natural resources in USAID-funded projects include:

Soil Conservation: General soil conservation practices include no-tillage, conservation tillage, terracing, green manure and cover crops, incorporation of compost and manure, use of mulches, and contour plowing (perpendicular across hillsides).

Water Conservation: Water conservation practices include many of the above soil conservation strategies, as well as minimization of losses due to evaporation or runoff by drip irrigation, chiseling compacted soils creating furrow dikes to prevent runoff, and using soil moisture and rainfall sensors to optimize irrigation schedules. Water conservation during processing includes use of shutoff valves and nozzles, reduced water pressure and usage, and dry processing of some products.

Biodiversity and Tropical Forestry Resources Conservation: Biodiversity and tropical forestry conservation can be promoted, even if protected areas occur near agricultural production sites, by using sound land use and planting non-crop species of trees and other plants necessary for wildlife establishment and protection. Some S&C systems now require protection of diversity and trees. Conservation of natural resources to make plastics, glass, metals, and paper products is dealt with through recycling programs, and recycling practices are now part and parcel of S&C and CP3 systems.

USAID/Guatemala beneficiaries are experiencing the following crop-specific conservation issues (Clay 2004), as outlined below.

Table 1: Crop production and processing issues related to conservation of natural resources

Crop	Production Issues	Processing Issues	Best Practices
Coffee Coffee is produced primarily as an export cash crop.	**Production issues include:** conservation of primary forest habitat; soil erosion and degradation; agrochemical use and runoff; processing effluents, water and energy use.	**Processing issues include:** amounts of energy and water used for coffee cherry washing, de-pulping, fermentation and drying; liquid and solid wastes disposal.	**Best practices:** shade-grown coffee planted under diverse over-story trees; S&C systems including Organic, Fair Trade and others; use of sulfur and copper to control diseases, and use of agricultural oils for scales (escama or cochinilla); good processing practices that conserve and save water, energy and solid organic wastes through composting and potential production of biogas.
Mango, Fruit Trees Mango trees grow on most tropical and subtropical soils. Saplings grow best where the soil has few rocks and permits numerous branch roots to anchor the trees.	**Production issues include:** conservation of primary forest and transitional habitats; agrochemical use and runoff; irrigation water use and conservation; and processing effluents.	**Processing issues include:** amounts of energy and water used for mango thermal treatment and washing; liquid and solid wastes disposal.	**Opportunities for improvement include use of:** In areas with insufficient rainfall, mango trees can be watered with drip irrigation, conserving water. Copper and sulfur oil solutions can be used in place of synthetic fungicides to control *Anthracnose* and *Cercospora* diseases, whereas agricultural oils can be used to control scales (escama or cochinilla). Quantities of organic fertilizers are available throughout Guatemala and are very cost-effective when compared with mineral fertilizers which have quadrupled in cost over 2008. Weeds can be controlled by mechanical cutting in properly planted and spaced orchards. Mature mango trees help prevent erosion. In many places, mango processing wastes can be composted and used to make biogas.
Avocado Avocado production issues include: conservation of primary forest habitat; soil erosion; and some use of agrochemicals.		**Processing issues include:** amounts of water used for cleaning; recycling of packaging materials.	**Opportunities for improvement include:** For small to medium producers, avocado can be inter-cropped with fruit-bearing shrubs and annual vegetables to help conserve biodiversity and reduce pest populations. Biological control works well in avocado orchards to prevent and manage pests, such that few agrochemicals are needed, and then only on spot-treatment bases. Mulches can be used to build and hold soil structure. Pruning is used to eliminate and manage Anthracnosis. Proper irrigation and mowing prevent weed build-up. Sanitation is important to collect dropped fruit and keep it away from rodents, as well as eliminate sources of pests and disease inocula.

Crop	Production Issues	Processing Issues	Best Practices
Melons Melon production issues include: Melon production presents numerous environmental and conservation challenges. Soil degradation, use of highly toxic nematocides and soil salinization are prominent among those.		**Processing issues include:** amounts of water used for cleaning; recycling of packaging materials.	**Opportunities for improvement include:** Cover crops and green manure crops restore soil fertility and retain soil. Watermelon has numerous pest constraints, with the potential for intensive use of agrochemical inputs. The following Integrated Crop Management (ICM) techniques help resolve some environmental and conservation challenges: Improved soil preparation techniques and timing; drip irrigation installation; increased plant populations with uniform densities; use of starter solution and biological controls; dedicated fertilization programs and fertigation for improved nutrition; weed control inside and around the crop to reduce pest and disease pressure (particularly from neighbors); pest and disease monitoring with timely and efficient control applications when necessary; implementation of GAPs based on the GlobalGAP protocol, including controls, follow-up and monitoring of the crops with records, improved infrastructure and environmental and social considerations; and sampling systems for harvest estimates, quality assessments, dates and projections.
Vegetables The production of traditional and oriental vegetables for local markets presents some of the greatest challenges for market growers and processors.	**Production issues include:** intensive use of agrochemical inputs, several of which have exceptional toxicities and risks to human health and environmental resources; intensive tillage leading to erosion and soil degradation; inefficient use of water; and sanitation/food safety.	**Processing issues include:** food safety issues; solid wastes disposal; conservation of water and energy for cleaning, packaging and chilling; recycling of packaging materials.	**Opportunities for improvement:** Many of the IPM techniques discussed above can be used to reduce pesticide use. Further, GlobalGAP outlines numerous techniques for managing production quality constraints. Best Processing Practices can be used to increase water quality, conserve water and energy, and properly dispose of wastes by land-filling or composting to make new soil amendments.

Further, most natural resources in the farm environment provide needed goods and services for crop production and other human needs. These resources – which need to be protected to the extent possible – and some of the benefits they provide are identified in the table below:

Table 2: Guatemala Environmental Services Provided to Farmers by Natural Resources

Critical Resource	Beneficial Function
Diverse forest cover	Fruits/nuts/medicines, increase biodiversity, reduce erosion, increase soil fertility, recreation/tourism, purify air, mitigate floods/droughts & maintain watersheds
Quality clean water	Crop irrigation/nutrition, processing agricultural produce, bathing/drinking water services
Rich soil microbial/chemical health	Pest management and plant nutrition services
Fish	Human food, ecosystem web functioning and services
Honeybees	Crop pollination services, proper ecosystem web functioning services
Birds	Field pest management services, proper ecosystem web functioning services
Reptiles	Field pest management services, proper ecosystem web functioning services
Amphibians	Proper aquatic ecosystem web functioning and services
Earthworms	Proper soil fertility and friability services
Mollusks	Human food and aquatic ecosystem services
Crustaceans	Human food and aquatic ecosystem services
Aquatic insects	Proper aquatic ecosystem web functioning and services
Plankton	Proper aquatic ecosystem web functioning and services

AGRICULTURE PRODUCTION AND CLIMATE CHANGE

Agriculture impacts and is impacted by climate change. Agriculture contributes to greenhouse gas emissions through land use in four main ways:

- CO_2 releases linked to deforestation
- Methane releases from rice cultivation
- Methane releases from enteric fermentation in cattle
- Nitrous oxide releases from fertilizer applications

The IPCC (Intergovernmental Panel on Climate Change) has predicted that important crops and livestock production in drier areas of Latin America will decrease. Droughts will impact the availability and quality of irrigation water. As ocean water temperatures increase, storm intensity and adverse weather events may increase soil erosion and landslides in poor areas not terraced or protected. Extreme rainfall events may lead to a more vigorous hydrological cycle, leading to decreases in soil fertility.

As temperatures increase, insect and disease pests may increase as well, followed by increases in use of pesticides. The 2001 IPPC Third Assessment Report concluded that the poorest countries would be hardest hit, with reductions in crop yields in most tropical and sub-tropical regions due to decreased water availability, and new or changed insect pest incidence. In Africa and Latin America many rainfed crops are near their maximum temperature tolerance, so that yields are likely to fall sharply for even small climate changes; falls in agricultural productivity of up to 30% over the 21st century are projected.

All of these possibilities will increase the pressure on agricultural systems, like those supported by EGP, to more quickly adopt GAPs and IPM practices in order to reduce pesticide and mineral fertilizer use as well as conserve forest, water and soil resources.

2.4 GUATEMALA AGROCHEMICAL SYSTEM RISK PROFILE INDICATORS

In every country, there exist factors that increase or decrease the risk profile of the agrochemical inputs system. These risks have been categorized into groups and enumerated below as "Factors That Increase Risks from Agrochemicals" and "Factors that Reduce Risks From Agrochemicals." The majority of export crops being promoted by USAID/Guatemala, such as vegetables and fruits, use numerous toxic

pesticides in traditional cropping systems. Guatemalan farmers obtain their pesticide products by (i) purchasing from local retail operations ("Agroservicios"), (ii) purchasing (usually on credit) directly from the export company or cooperative to which they provide product, or (iii) receiving a "kit" of seed, fertilizer and pesticide inputs (again, on credit) from the export company or cooperative to which they provide products. In general, S&C systems being promoted by USAID's implementation partners prescribe the use of lower risk pesticides.

FACTORS THAT INCREASE RISKS FROM AGROCHEMICALS

The PERSUAP identified the following ongoing practices that increase risk inherent in the cropping and input systems found in Guatemala.

- The presence of very highly toxic pesticide active ingredients on MAGA's registered pesticides list, and some of which are being used and should not continue to be used – especially on field vegetables/oriental vegetables, some tree crops, coffee and melons. Note that most rodenticides are Class I, but the method of application – mainly in baits as opposed to being sprayed, greatly reduces human exposure risks. These include (from Annex 5) the following pesticide AIs:

Table 3: Pesticide Active Ingredients (AI)

Active Ingredients	Classification
Insecticides	
aldicarb	RUP Class I, systemic for long period in crop
carbofuran (carbofurano)	RUP, Class I
disulfoton	Class I
ethoprophos (etoprofos) ()	RUP, Class I
Fenamiphos	RUP, Class I
methamidophos	RUP, Class I, PIC list
methiocarb (metiocarb)	RUP, Class I
methomyl (metomil)	RUP, Class I
methyl parathion (metil paration)	not EPA registered, RUP, Class I
naled	RUP, Class I
oxamyl (oxamil, nematocide)	RUP, Class I
oxydemeton methyl (oxidemeton metil)	RUP, Class I
phorate (forato)	RUP, Class I
phosphamidon (fosfamidon)	not EPA registered, RUP, Class I, on PIC list
terbufos	RUP, Class I
triazophos (triazofos)	not EPA registered, Class I
zeta cypermethrin (zetacipermetrina)	RUP, Class I
Fungicides	
edifenphos (edifenfos)	not EPA registered, Class I
fenpropimorph	not EPA registered, Class I

Active Ingredients	Classification
fentin hydroxide	hidroxido) (RUP, Class I
imazalil sulfate (imazalil sulfato)	Class I
TCMTB (busan)	Class I
Nematocides	
aldicarb	RUP, Class I
fenamiphos	RUP, Class I
fosthiazate (fostiazato)	RUP, Class I
metam sodium	RUP, Class I
methyl bromide (bromuro de metilo)	RUP, Class I, Montreal Protocol chemical
oxamyl	RUP, Class I
Fumigants	
aluminum phosphide (fosfuro de aluminio)	RUP, Class I
magnesium phosphide (fosfuro de magnesio)	RUP, Class I
metam sodium	RUP, Class I
methyl bromide (bromuro de metilo)	RUP, Class I, Montreal Protocol chemical
zinc phosphide (fosfuro de zinc)	RUP, Class I
Fruit Ripening Chemical	
ethylene gas (etilen)	Class I

- The official list of 3,667 registered pesticide products provides information on whether a pesticide is permitted or banned from Guatemala. Though broad, with many options and repetitions of some of the same chemicals in different or differently-named products, the list is large, cumbersome, and likely to be difficult for farmers to navigate and comprehend. By comparison, Eastern European countries which actively seek markets for their fruits and vegetables in Western Europe, have limited the number of pesticide products that are approved and included on published lists to an average of 300-500. It is also common for countries to have separate lists of pesticides that are banned or no longer permitted for import and use. Guatemala has such a list, with mostly POPs and PIC chemicals.

- Many Guatemala farm laborers and some farmers are not sufficiently literate to read pesticide labels or other warning media. For those who are sufficiently literate, many pesticide labels and warning signs in farm stores were written just in Spanish, not in common Mayan languages.

- Insufficient stocks of PPE were found to be available for sale in farm input stores, probably reflecting low demand.

- Interviews revealed that many untrained Guatemalan farmers will not use PPE even if it is affordable and available. This is especially true of traditional agricultural production for local consumption, and less so for crops produced under the control of S&C-GAP systems, like those supported by USAID.

- Web references on pesticide issues in Guatemala indicate that few farmers and most farm laborers likely do not understand the human health risks of individual pesticides or classes of pesticides.
- Guatemala has had US fruit and vegetable import shipments refused, mostly due to pesticide residue contamination. New FDA data (http://www.accessdata.fda.gov/cms_ia/country_GT.html) containing import alerts demonstrate that on-going compliance problems exist for several vegetable (squash/zucchini, sugar snap and snow peas, French beans) and fruit (blackberries, strawberries, raspberries, pineapple) crops. Pesticides either banned or present above MRLs identified within the import alerts include: dimethoate, triadimenol, permethrin, methamidophos (now banned in Guatemala), pirimiphos methyl, hexaconazole, endosulfan (being phased out by EPA; likely to be banned soon by the POPs treaty), oxamyl, chlorpyrifos, imazalil, and chlorothalonil.
- One of the USAID Guatemala projects noted that they still encounter illegal residues of methamidophos (banned, on PIC list) and aldrin (on internationally-banned POPs list) on tomatoes grown by their contract farmers.
- Increased use of herbicides poses greater risk of ground and surface water source contamination affecting drinking water, and creating resistance in the weeds being controlled.
- Overuse, improper applications, and routine use of the same pesticides (or chemical) increases risk of pest resistance.
- Lack of knowledge of when to use a specific pesticide during the life cycle of the pest leads to ineffective pest control, waste of funds, and potential human hazards.
- Guatemala has the highest concentration of biological diversity of any country in Central America with over 1,966 species, 333 of which are threatened.
- Guatemalan farmers still apply—with bare feet—soil drench pesticides containing oxamyl; and they routinely dissolve highly toxic aluminum phosphide tablets (designed to be a fumigant) in backpack sprayers with water and apply to crops like corn as a sprayable insecticide.
- When produce prices are high and record-keeping is insufficient, some contract farmers may try to buy produce from uncertified neighboring farms (which are not under technical direction for pesticide types and MRLs) to sell with their contract batch.
- At least 37 insecticides and herbicides, including organoclhorates, 15 of which have been prohibited since 1988, contaminate the Motagua watershed and Lake Amatitlán. The southern coastal region has higher levels of herbicides and insecticides in the surface water than the northeastern region. The Villalobos River, which drains Amatitlan Lake, is one of the country's most polluted rivers due to high levels of household and garden chemicals, and above all, from herbicides and insecticides that are used in the agriculture areas under intense farming, in the small watershed of the Platanitos River[13].
- A major problem cited by Agrequima, exporting companies and MAGA is the large number of unregistered pesticide retail stores ("agroservicios"). Reasons cited for this lack of government oversight included lack of resources within MAGA and legal barriers, i.e., the existing law does not provide for meaningful enforcement or adverse consequences for pesticide retail outlets that are not registered.

[13] http://www.usaid.gov/gt/docs/tropical_forrest_assesment.pdf

FACTORS THAT REDUCE RISKS FROM PESTICIDES

The World Health Organization (WHO) has classified pesticides by human toxicity and developed a color-coding scheme easily-recognizable to illiterate farmers. The color coding scheme follows:

WHO Acute human toxicity	Pesticide Label Color Code
Class Ia- Extremely hazardous	Red
Class Ib- Highly hazardous	Red
Class II- Moderately hazardous	Yellow
Class III- Slightly hazardous	Blue
Class U- Unlikely to present acute hazard in normal use	Green

The increasing availability and use of relatively low acute mammalian toxicity; organic-certified products from natural sources like oils, soaps, sulfur, copper, microbes, plant and microbe extracts; products with low environmental impact; and the use of GAPs are leading to changes in agricultural use of pesticides and a reduction in risk of that use. Although natural products and low toxicity pesticides may work more slowly than conventional synthetic pesticides, many have been proven to be as effective, and to present lower human health and environmental risks. Though a few remain, the most toxic red-label products are rapidly disappearing from pesticide shop shelves, world-wide. For example, in 2009, Guatemala banned the use of methamidophos, one of the most toxic chemicals on the PIC list, which was responsible for rejection of numerous snow pea shipments to the United States.

The PERSUAP identified the following ongoing practices that help reduce risks inherent in the cropping and input systems found in Guatemala:

- S&C systems for export of produce to US markets now gaining access to local, sufficiently equipped, and accredited/certified laboratories to conduct soil, water, and pesticide residue analyses (although there need to be more with a rapid turnaround time of less than 5 days, pure pesticide standards and a cost of less than $150 per sample).

- Many of the pesticide products available in farm input stores visited bore the WHO standard green-banded label indicating "unlikely to be a hazard," while some bore blue labels (slightly hazardous) and yellow labels (moderately high toxicity). The number of red-label (highly toxic) pesticides for sale was generally no more than 2-3 products. Note: Care should be used when judging pesticide toxicity by label color. Although the WHO standard is by far the most widespread, alternate systems exist. For example, see: http:// www.worldagroforestry.org/NurseryManuals/Community/SafePesticides.pdf.

  Excerpt: "In Latin America chemicals are rated and labeled based on their toxicity, or how much of the chemical it would take to kill a person.

  Green label — lightly toxic Yellow label — moderately toxic

  Blue label — very toxic Red label — extremely toxic"

  This system conflicts directly with WHO labeling system!

- Many shops had professionally packaged green-label biological and organic pesticides (e.g. neem oil, Bacillus thuringiensis (BT), bacterial extract sphinosad, oils with copper and sulfur, and extracts of garlic and chili pepper) for sale at reasonable prices. Many newer nicotinoid insecticides are also now available.

- All farm input stores visited were well organized with pesticides stored in plastic bottles (as opposed to breakable glass or metal containers susceptible to rust), on shelves by type, and kept above tiled (easy to clean and non-absorbent) or cement floors.
- Without exception, pesticide bottles were unopened, there were no re-packaged pesticides in inappropriate containers for sale, and there were no weight balances for subdividing and selling small portions of pesticides. These conditions represent BMPs for pesticide storage.
- The warehouses of the large distributor Bayer Crop Sciences were well lit, clean, and well ventilated so that pesticide odor could not be detected.
- The majority of Guatemala producers for name-brand chains like HortiFruti and Wal-Mart, as well as exporters will have to follow local and US standard systems in order to reach the respective markets. Many export-oriented farms are managed following S&C systems such as GlobalGAP, Organic, and Fair Trade. These systems require IPM measures and tend to produce reduced-risk pesticide products.
- The increasing availability of small, single-use sachets and smaller bottles of pesticides (as opposed to one-and five-liter bottles) with labels containing appropriate safety information in Spanish that are marketed by the formal pesticide importer/distributor sector. These small, labeled packages help resolve on-farm pesticide quantity storage and use issues.
- No illegal or internationally banned products or active ingredients from the chlorinated hydrocarbon group were found in any of the farm input stores or distributors visited. Two chlorinated hydrocarbon pesticides – endosulfan and dicofol – that are not yet banned were found in farm stores. Both pesticides are currently under review to be internationally banned or restricted).
- Labeling and packaging of all pesticide containers from importers/distributors were intact and legible.
- Most of the pesticide sellers understood many crop production constraints, pesticides/dosages to use against the constraints, risks that come with pesticide use, and the need for PPE, though this awareness needs to increase.
- There was little on-farm evidence of pesticides losing their efficacy due to product adulteration, low quality generic ingredients, or development of resistance. However certain USAID/Guatemala programs could require monitoring and evaluation (M&E) for verification.
- There was little to no field evidence of domestic animal or environmental poisoning (like fish kills) collected from interviews with pesticide sector actors. According to Agrequima, human deaths do still occur with pesticides, but they are decreasing in some major pesticide use areas.
- Bayer CropScience has developed systems for promoting farmer use of safety gloves when mixing pesticides (where risk is high) and triple rinsing empty pesticide bottles before disposal. Foreseeing issues with endosulfan, Bayer CropScience, has stopped producing it.
- AgreQuima has developed a program for collecting empty pesticide containers in areas of high use, cleaning them and recycling them into plastic furniture.
- USAID has funded some agro-meteorological weather data stations that help farmers predict pest outbreaks and then use lower amounts of pesticides.
- Export companies/cooperatives all agreed that export requirements are more stringent for Europe than for the USA or Canada.

- Export produce pre-certification mechanisms may maintain or open future markets and reduce non-compliance and shipment rejection issues.
- Farmers affiliated with well-managed export companies often use detailed crop production plans and keep detailed written records of pesticide and fertilizer usage for a given crop.
- Some export companies/cooperatives have implemented a "traceability" plan, even for non-certified farm produce.

Although there are many encouraging findings in the pesticide wholesale and retail systems, as well as on S&C farms observed in the Guatemala, there still remain some issues that can increase the risk of exposure among farmers, laborers, farm family members, and even international consumers to dangerous poisons, and polluting their environment. Thus the pesticide risk profile for Guatemala is higher than might be encountered in more developed countries, though it is rapidly improving as S&C-GAP systems are being implemented and rules for export Minimum/Maximum Residual Levels/Limits (MRLs) are adopted. Extra care will be needed to promote and implement effective mitigation measures.

2.5 GOOD AGRICULTURE PRACTICES AND INTEGRATED PEST MANAGEMENT FOR GUATEMALA

While pesticides are considered an integral part of IPM, and IPM is an integral part of USAID agricultural development programs, the use of pesticides needs to be judicious and cautious. That includes so-called "natural" pesticides like extracts from plants, minerals, and bacteria as well as those synthesized in a laboratory or factory. Over the past 20 years, IPM has become a major element of market-driven GAPs like Global GAP, British Retail Consortium-BRC, Fair Trade, Organic, and other S&C systems. Food safety incidents and food poisoning deaths have been publicized in domestic and international news, and have hastened the pace for GAP adoption. Numerous IPM practices are in place and used in Europe, the United States and a number of tropical countries for high-value crops like coffee, cacao, and some fruits, and they are being actively used by organic as well as conventional farmers. High fuel costs drive up the costs for most synthetic fertilizers and pesticides, which increases the cost-effectiveness of IPM and other production and pest control options.

Finally, IPM has influenced the development of other "integrated" production system components including, Integrated Soil Fertility Management (ISFM), Integrated Weed Management (IWM), Integrated Crop Management (ICM), and Integrated Vector Management (IVM) for livestock and human disease vectors.

The bases for these GAP and IPM systems are as follows:

The use of GAPs ensure the production of strong, vigorous plants (that can resist or tolerate pest damage) and safe food, while IPM focuses on decreasing risks from certain pests and other constraints to production.

GAPs emphasize maintaining proper plant health, and thus *prevention* of problems, through use of:

- Quality hybrid pest- and constraint-resistant treated seed
- Proper land preparation and tillage such as sowing in raised-bed plantings
- Soil fertility testing, monitoring, and management

- Water and soil moisture testing and management to avoid salinity, bacterial and chemical contaminants, and soil-borne diseases
- Nutrient management through use of combinations of biological and mineral fertilizers
- Organic matter management through use of manures, composting, and mulching
- Proper pesticide choice, storage, use, and disposal.

IPM can include possible pest management techniques and tools including:

- Pest scouting, monitoring, and identification for accurate decision-making
- Cultural methods that promote pest avoidance and a healthy plant that can better tolerate or resist pests. These methods include, but are not limited to, use of resistant varieties, early/late planting/harvesting, crop rotation, pruning, destruction of crop residues and pest refuge plants near fields, and GAP practices..
- Natural pest control by encouraging and protecting parasitoids, predators, and pest diseases (i.e. planting predator-attracting plants/flowers on field margins)
- Mechanical weed or insect pest control using manual, hoe, and machine practices
- Chemical practices such as use of judicious, knowledgeable, and safe application of synthetic and "natural" (derived from nature, extracted from plants, microbes, and other organisms) pesticides.

IPM is more effective than synthetic pesticides in the long run; less damaging to essential soil health and nutrient cycling, requires less capital (but more labor) investment, and can be used preventatively to eliminate or minimize the need for "responsive" controls. Annex 2b provides a ten-step process for designing and implementing an IPM program,

SECTION 3. PESTICIDE EVALUATION REPORT

This part of the PERSUAP, the Pesticide Evaluation Report, addresses pesticide choices based upon environmental and human health issues, uses, alternate options, IPM, biodiversity, conservation, training, PPE options, monitoring and mitigation recommendations according to the twelve Regulation 216.3(b)(1) Pesticide Procedures Factors, analyzed below.

3.1 FACTOR A: USEPA REGISTRATION STATUS OF THE PROPOSED PESTICIDE

EGP projects are effectively limited to recommending pesticides containing active ingredients (AIs) in products registered in Guatemala, and in the US by the EPA for the same or similar uses. Emphasis is placed on "similar use" because a few of the crops and their pest species found overseas are not present in the US, and therefore pesticides may not be registered for the exact same use, but often are registered for similar pests and pest situations.

The USEPA now categorizes pesticides as either "registered" or "not registered." Moreover, some AIs and products containing them are labeled as Restricted Use Pesticides (RUPs). In the US, the pesticides and active ingredients that are labeled RUPs can only be sold to and used by certified applicators or persons under their direct supervision, and only for those purposes covered by the applicator's certification (such as for row crops, or tree crops, or structural pests, etc.). It is very important to note that in many cases EPA's intent for restriction is based on large-scale commercial farms found in the US, often hundreds or thousands of hectares, where errors can magnify risks and impacts; while in developing countries like Guatemala, scale is often no more than 2 hectares, with scattered and asynchronous pesticide applications that are much less likely to lead to the same magnitude of errors and impacts. Thus, USAID considers such RUP pesticides very carefully, with an eye on EPA's intent and issues of scale.

Pesticide AIs in specific products must also be registered for legal import and use by the target countries – in this case, Guatemala. One caveat is that pesticides that have lost active registration status in developing countries are often permitted to clear the retail system, and can be found on farm store shelves for 2-3 years during the clearing process period (most pesticides have an expiration date of two years after the manufacture date, and most are still viable and usable for an additional year).

The USEPA classifies pesticides according to actual toxicity of the formulated products, taking formulation types and concentrations into account, thus generally making the formulated product less toxic than the active ingredients alone. This method of classifying acute toxicity is more accurate and representative of actual risks encountered in the field. By contrast, the WHO acute toxicity classification system is based on the active ingredient only (see Annex 7 for a comparison of USEPA and WHO acute toxicity classification systems), and although WHO deals primarily with pesticides used in health applications (e.g., indoor residual spraying for elimination of malaria vectors), the classification has been adopted more generally by the UN to include agricultural pesticides.

This PERSUAP contains two pesticide analysis tables, the first of which analyzes—comprehensively—all of the AIs in all pesticides registered for import and use in Guatemala, so that project implementers can make wise future choices, and this is contained in Annex 3. The second table is presented below and analyzes specific pesticides recommended in Annex 1 by the twelve Regulation 216 Factors (A-L). Refer to these tables in Annex 3 for the Regulation 216 analyses, below.

	Table 4 of Analysis of Recommended Pesticides by the 12 Required Regulation 216 Factors (A-L) Including Registration in Guatemala													
Number	Pesticide Name/Formulation	Factor A: EPA Registration numbers	MAGA Registration status/Number	Factor B: Selection Basis	Factor C: Part of IPM Program?	Factor D: Application method	Factor E: Human Chronic Toxicity?	Factor F: Efficacy in Guatemala?	Factor G: Environmentally compatible?	Factor H: Use Conditions/ Water pollution?	Factor I: Pesticide alternatives?	Factor J: Government control abilities?	Factor K: Training present?	Factor L: Monitoring present?
	Key: PC=potential carcinogen; ED=potential endocrine disruptor; RD=potential reproductive of developmental toxin													
1	Actara 25 WG (Thiamethoxam)	100-938	130-302-184-B; 697-302-184-B	Efficacy	Yes	Back pack sprayer	PC	Yes	Yes	No data	Yes	Yes but weak	Yes	Yes
2	Agriculture dormant oil (several products)	4-80, 192-188, 9779-251	_862-8-1; 789-862-8-B	Efficacy	Yes	Back pack sprayer	None	Yes	Yes	No data	Yes	Yes but weak	Yes	Yes
3	Ally 60 WG (Metsulfuron methyl)	352-435	_479-11-2	Efficacy	Yes	Back pack sprayer	None	Yes	bees, birds and Aquatic toxicity	No data	Yes	Yes but weak	Yes	Yes
4	Alto 100 SL (cyproconazole)	100-1226	E-32-302-2011	Efficacy	Yes	Back pack sprayer	PC	Yes	Yes	No data	Yes	Yes but weak	Yes	Yes
5	Amistar 50 WG (Azoxystrobin)	100-1164	_302-220-1; _302-220-2; _302-220-3; 802-302-220-B;	Efficacy	Yes	Motorized Back Pack	None	Yes	bees, birds and Aquatic toxicity	Potential	Yes	Yes but weak	Yes	Yes
6	Avaunt 30 WG (Indoxacarb, S isomer)	352-597	899-396-132-B; _396-132-2; _659-2-1; 396-659-2(INNC)-B	Efficacy	Yes	Back pack sprayer	None	Yes	Bees, birds toxicity	No data	Yes	Yes but weak	Yes	Yes
7	Bacillus thuringiensis (several products)	4-226, EPA Registration Standard 89-023	396-613-8-B; E-01-503-2012; E-01-503-2011; 613-8; 697-292-1-B; 802-292-1-B	Natural	Yes	Motorized Back Pack	None	Yes	Yes	No data	Yes	Yes but weak	Yes	Yes

	Table 4 of Analysis of Recommended Pesticides by the 12 Required Regulation 216 Factors (A-L) Including Registration in Guatemala													
Number	Pesticide Name/Formulation	EPA Registration numbers	MAGA Registration status/Number	Selection Basis?	Part of IPM Program?	Application method?	Human Chronic Toxicity?	Efficacy in Guatemala?	Environmentally compatible?	Water pollution?	Pesticide alternatives?	Government control abilities?	Training present?	Monitoring present?
	Key: PC=potential carcinogen; ED=potential endocrine disruptor; RD=potential reproductive of developmental toxin													
8	Balear 50 SC (Chlorothalonilo)	50534-8	396-613-8-B; _752-58-1; _479-88-8; 138-3; E-28-33-2011; _479-76-1	Efficacy	Yes	Back pack sprayer	None	Yes	Aquatic toxicity	Potential	Yes	Yes but weak	Yes	Yes
9	Confidor 35 SC, Plural 20 Sl (Imidacloprid)	EPA PC 129099	_84-20-3	Efficacy	Yes	Back pack sprayer	None	Yes	Birds and Aquatic toxicity	Potential	Yes	Yes but weak	Yes	Yes
10	Copper sulfate (several products)	4-474, 4-58, 56576-1	800-45-45-B	Efficacy	Yes	Backpack sprayer	None	Yes	Aquatic toxicity	No data	Yes	Yes but weak	Yes	Yes
11	Cycosin 50 SC (Metil Tiofanato) Thiophanate-methyl	1381-222	752-128; 415-78-85-B; 194-21	Efficacy	Yes	Back pack sprayer	PC, RD	Yes	Aquatic toxicity	Potential	Yes	Yes but weak	Yes	Yes
12	Ditera DT (Myrothecium verrucaria)	73049-67	E-13-33-10	Efficacy	Yes	Backpack sprayer	None	Yes	Yes	No data	Yes	Yes but weak	Yes	Yes
13	Extracto de ajo/allicin (garlic extract, several products)	5905-531, 44688-1	E-4-396-09; 800-45-57-B	Efficacy	Yes	Backpack sprayer	None	Yes	Yes	No data	Yes	Yes but weak	Yes	Yes

	Table 4 of Analysis of Recommended Pesticides by the 12 Required Regulation 216 Factors (A-L) Including Registration in Guatemala													
Number	Pesticide Name/Formulation	EPA Registration numbers	MAGA Registration status/Number	Selection Basis?	Part of IPM Program?	Application method?	Human Chronic Toxicity?	Efficacy in Guatemala?	Environmentally compatible?	Water pollution?	Pesticide alternatives?	Government control abilities?	Training present?	Monitoring present?
	Key: PC=potential carcinogen; ED=potential endocrine disruptor; RD=potential reproductive of developmental toxin													
14	Flint 50 WG (Trifloxistrobin)	264-777	130-302-248A-B; E-6-189-09	Efficacy	Yes	Back pack sprayer	None	Yes	Bird toxicity	No data	Yes	Yes but weak	Yes	Yes
15	Forum 15 EC, Acrobat 50 wp (Dimethomorph)	241-427	887-45-75-B; 296-775-5-B	Efficacy	Yes	Back pack sprayer	None	Yes	bees, birds and Aquatic toxicity	No data	Yes	Yes but weak	Yes	Yes
16	Goal 2xl (Oxyfluorfen)	62719-424	_479-58-1, _479-58-2	Efficacy	Yes	Back pack sprayer	PC	Yes	Aquatic toxicity	No data	Yes	Yes but weak	Yes	Yes
17	Indar 50 OF (Fenbuconazole)	62719-421	E-4-479-08	Efficacy	Yes	Back pack sprayer	PC, ED	Yes	Aquatic toxicity	Potential	Yes	Yes but weak	Yes	Yes
18	Intrepid 24 SC (Methoxyfenozide)	62719-442	_479-81-4; _479-81-5	Efficacy	Yes	Back pack sprayer	None	Yes	Bees and Aquatic toxicity	Potential	Yes	Yes but weak	Yes	Yes
19	Iprodione Tecnico (Iprodione)	66330-300, 66330-297 (not for asparagus)	800-45-58-B	Efficacy	Yes	Motorized Back Pack	PC	Yes	Aquatic toxicity	Potential	Yes	Yes but weak	Yes	Yes

	Table 4 of Analysis of Recommended Pesticides by the 12 Required Regulation 216 Factors (A-L) Including Registration in Guatemala														
Number	Pesticide Name/Formulation	EPA Registration numbers	MAGA Registration status/Number	Selection Basis?	Part of IPM Program?	Application method?	Human Chronic Toxicity?	Efficacy in Guatemala?	Environmentally compatible?	Water pollution?	Pesticide alternatives?	Government control abilities?	Training present?	Monitoring present?
	Key: PC=potential carcinogen; ED=potential endocrine disruptor; RD=potential reproductive of developmental toxin													
20	Kaolin (several products)	61842-15, 61842-17,61842-16	E-3-396-06	Efficacy	Yes	Backpack sprayer	None	Yes	Yes	No data	Yes	Yes but weak	Yes	Yes
21	Knack (pyriproxyfen)	59639-95	532-613-12-B;	Efficacy	Yes	Backpack sprayer	None	Yes	Yes	No data	Yes	Yes but weak	Yes	Yes
22	Kocide WG (copper hydroxide)	1812-338, 352-684	E-19-33-08; E-24-33-08	Efficacy	Yes	Backpack sprayer	None	Yes	Yes	No data	Yes	Yes but weak	Yes	Yes
23	Malathion 50 EC (Malathion)	33955-394	851-2; 659-84-37-B; 879-1; E-4-396-08; E-2-396-08; E-3-396-08; 19-479-84-B; 33-643; 33-644; 33-645; 357-159; 357-160; 357-161; 884-1; 833-6; 82-722-1-B; 82-722-2-B	Efficacy and cost	Yes	Back pack sprayer	PC, ED	Yes	Bees, birds, and acquatic toxicity	Potential	Yes	Yes but weak	Yes	Yes
24	Manzate 80 WP (Mancozeb)	352-705	753-521-17(1NNC)-B; 498-13; 84-752-62(4NNC)-B	Cost	Yes	Motorized Back Pack	PC,ED,RD	Yes	bees, birds and Aquatic toxicity	No data	Yes	Yes but weak	Yes	Yes
25	Mimic 24 sc (Tebufenozide)	8033-111	937-08; 19-479-63-B	Efficacy	Yes	Back pack sprayer	None	Yes	Aquatic toxicity	Potential	Yes	Yes but weak	Yes	Yes

	Table 4 of Analysis of Recommended Pesticides by the 12 Required Regulation 216 Factors (A-L) Including Registration in Guatemala													
Number	Pesticide Name/Formulation	EPA Registration numbers	MAGA Registration status/Number	Selection Basis?	Part of IPM Program?	Application method?	Human Chronic Toxicity?	Efficacy in Guatemala?	Environmentally compatible?	Water pollution?	Pesticide alternatives?	Government control abilities?	Training present?	Monitoring present?
		Key: PC=potential carcinogen; ED=potential endocrine disruptor; RD=potential reproductive of developmental toxin												
26	Mitigan 18.5 EC (Dicofol)	66222-21	_898-49-1; 117-898-49-B; 898-49; 117-243-24-B	Efficacy	Yes	Back pack sprayer	PC,ED	Yes	Aquatic toxicity	No data	Yes	Yes but weak	Yes	Yes
27	Naturalis L (Beauveria bassiana)	53871-9	E-2-189-2009; E-3-189-2009; E-2-211-05	Natural	Yes	Back pack sprayer	None	Yes	Yes	No data	Yes	Yes but weak	Yes	Yes
28	Neem Oil (Azadirachtina)	70310-2	930-1	Cost, Natural	Yes	Back pack sprayer	None	Yes	Aquatic toxicity	No data	Yes	Yes but weak	Yes	Yes
29	Oberon 24 SC (Spiromesifen)	264-719	33-602A; 33-602B	Efficacy	Yes	Back pack sprayer	None	Yes	Birds and Aquatic toxicity	No data	Yes	Yes but weak	Yes	Yes
30	Promax (tomatilla and thyme oils)	Not regulated: (Exemption 40 CFR 152.25(f))	E-13-130-06; E-17-130-06	Efficacy	Yes	Backpack sprayer	None	Yes	Yes	No data	Yes	Yes but weak	Yes	Yes
31	Pymetrozine 50 WG (Pymetrozine)	100-912	E-26-33-06; 723-6; E-3-130-06; 302-248A	Efficacy	Yes	Back pack sprayer	PC	Yes	Birds and Aquatic toxicity	Potential	Yes	Yes but weak	Yes	Yes
32	Rescate 20 SP (Acetamiprid)	8033-21	100-752-94-B	Efficacy	Yes	Back pack sprayer	None	Yes	Bees and birds toxicity	No data	Yes	Yes but weak	Yes	Yes
33	Roundup 36 SL (Glyphosate)	71995-22	100-752-12-B	Efficacy	Yes	Back pack sprayer	None	Yes	Aquatic toxicity	Potential	Yes	Yes but weak	Yes	Yes
34	Rovral (Iprodione)	264-453	641-3	Efficacy	Yes	Back pack sprayer	PC	Yes	Aquatic toxicity	Potential	Yes	Yes but weak	Yes	Yes

	Table 4 of Analysis of Recommended Pesticides by the 12 Required Regulation 216 Factors (A-L) Including Registration in Guatemala													
Number	**Pesticide Name/Formulation**	**EPA Registration numbers**	**MAGA Registration status/Number**	**Selection Basis?**	**Part of IPM Program?**	**Application method?**	**Human Chronic Toxicity?**	**Efficacy in Guatemala?**	**Environmentally compatible?**	**Water pollution?**	**Pesticide alternatives?**	**Government control abilities?**	**Training present?**	**Monitoring present?**
		Key: PC=potential carcinogen; ED=potential endocrine disruptor; RD=potential reproductive of developmental toxin												
35	Soap sprays (potassium salts of fatty acids, several products)	59913-3, 42697-2, 42697-1	E-1-800-08; _479-102-1;	Efficacy	Yes	Backpack sprayer	None	Yes	Yes	No data	Yes	Yes but weak	Yes	Yes
36	Thiovit, Kumulus DF, Sulfur (sulfur)	4-62, 51036-352, 70905-1 (Cosavet df sulfur on lettuce)	19-78-82A-B; _78-82-1	Efficacy	Yes	Backpack sprayer	None	Yes	Yes	No data	Yes	Yes but weak	Yes	Yes
37	Thiram 50 WP (Thiram) – (Seed treatment only)	264-942	752-48	Efficacy	Yes	Mix	ED,RD	Yes	Aquatic toxicity	No data	Yes	Yes but weak	Yes	Yes
38	Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC (Spinosad)	62719-267	617-479-28-B	Natural	Yes	Back pack sprayer	None	Yes	Bees and Aquatic toxicity	No data	Yes	Yes but weak	Yes	Yes
39	Trichoderma harzianum (several products)	61463-2, 68539-4, 68539-3	E-01-189-2012	Efficacy	Yes	Backpack sprayer	None	Yes	Yes	No data	Yes	Yes but weak	Yes	Yes
40	Trigard 75 WP (Cyromazine)	100-654	E-60-74-05; E-61-74-05	Efficacy	Yes	Backpack sprayer	None	Yes	Aquatic toxicity	Known	Yes	Yes but weak	Yes	Yes
41	Vertimec 1.8 EC (Avermectin)	228-658 (citrus, cucurbits, avocados), 228-657 (ornamentals)	_302-193A-2; _302-193A-3; _302-193A-4	Efficacy	Yes	Back pack sprayer	RD	Yes	bees, birds and Aquatic toxicity	No data	Yes	Yes but weak	Yes	Yes

PROJECT SPECIFIC PESTICIDE INFORMATION – MERCY CORPS

Mercy Corps has been carrying out work on rural value chain crops. However, if Mercy Corps plans to use pesticides other than those listed in the above table, or apply any of the above pesticides to crops other than those designated in the above table, it will need to carry out its own PERSUAP.

PROJECT SPECIFIC PESTICIDE INFORMATION – ANACAFE

Anacafe has recently been using a mix of methyl alcohol and ethyl alcohol as an attractant to trap the coffee berry borer with fair success. Other products used are consistent with the existing tables in this document, and no new chemical additions were reported.

ISSUE: PRODUCTS CONTAINING ACTIVE INGREDIENTS NOT EPA-REGISTERED

Annex 3 analyzes and Annex 5 lists Guatemala-registered pesticide AIs that are not registered by EPA in any products. Products and AIs that are not registered by EPA are *not permitted* for use on USAID-supported projects. They are either cancelled for use in the United States, or have insufficient market demand, and have thus not been through EPA's battery of environmental and human health tests.

One notable exception to this is Bordeaux Mix, which is very useful, relatively safe, and easy to make artisanally. While there are no EPA-registered formulations of the antique fungicide Bordeaux Mix on the US market (and thus none registered by EPA), Bordeaux components copper sulfate and hydrated lime are registered, available, and recommended for home-made production and use by the University of California at Davis[14]: (http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7481.html#BORDEAUX), one of the premier agriculture universities in the USA. This PERSUAP requests an exception be made for use by EGP projects of Bordeaux mix.

MITIGATION

EGP's beneficiaries do not use products containing these active ingredients that are not EPA registered (see Annex 5).

A SPECIAL ISSUE: RESTRICTED USE PESTICIDES

The EPA has developed a training and certification system to ensure the safe handling and use of pesticides with inordinate risks to human health and/or the environment. In the United States, farmers who wish to purchase and use RUPs must receive (and pay for) specialized training and certification to increase awareness of the risks and methods to mitigate these risks. These *Certified Applicators*, or those under their direct supervision, must follow the pesticide label instructions and only use the product for purposes covered under their certification. Further, in the US, some states may require that certain active ingredients not listed on the federal list be classified as "restricted" in their states due to local conditions, generally related to environmental concerns.

The EPA classifies a particular pesticide as restricted if it determines that the pesticide may be hazardous to human health or to the environment *even when used according to the label.*

[14] http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7481.html

Products are classified as restricted for several reasons including, but not limited to, the following:

- Fetotoxicity – causes adverse effects on the fetus
- Mutagenicity – causes genetic changes in the organism which may be passed on to its next generation
- Oncogenicity – causes tumors (not necessarily malignant)
- Carcinogenicity – causes cancer
- Teratogenicity – causes birth defects
- Accident history
- Ground and surface water concerns
- Causes adverse effects on wildlife, avian, or aquatic organisms, including fish and shellfish
- Presents a human inhalation hazard, dermal toxicity, corrosiveness to eyes, or acute oral toxicity hazard
- Presents concerns about worker exposure
- Presents hazard to non-target organisms
- Presents hazards to honeybees.

MITIGATION OF RUP RISKS IN GUATEMALA

- Do not use any RUPs (see Annex 5)

ADDITIONAL RECOMMENDATIONS FOR MITIGATION

- Continue training on GAPs/IPM, the production and use of pest management plans and safe pesticide use and management.
- Training will introduce beneficiary farmers to: pesticides not permitted for use, those the project recommends, and those that might be used with significant training and certification; IPM philosophy, tools and tactics; and Safe Pesticide Use practices including use of basic PPE.
- Get all project beneficiary farmers copies of Materials Safety Data Sheets to keep on-hand, with a source of exact information on risks and risk mitigations for each product, and what measures to take in case of an accidental spill, fire or poisoning. MSDS information can also be used during training.
- As this PERSUAP is amended, EGP Project Managers will need to report to USAID changes to less toxic products on the list of pesticides recommended to USAID.

3.2 FACTOR B: BASIS FOR SELECTION OF PESTICIDES

This procedure generally refers to the practical, economic, and/or environmental rational for choosing a particular pesticide. In general, best practices and USAID – which promotes IPM as policy – dictate that the *least toxic* pesticide that is effective is selected. Farmers look for a pesticide that has rapid knock-down action to satisfy the need to defeat the pest quickly and visibly.

Farmers using S&C-GAP systems for export crops focus more on factors such as human safety and low environmental impact, by necessity as much as by choice. Such lower toxicity pesticides may take longer

to kill the pest – usually after the farmer has left the field – but they are effective, nevertheless. Another factor of importance is the abeyance of pesticide-specific PHIs and MRLs, which can be influenced by choosing products with rapid post-application degradation.

As the analysis in Table 4 above shows, the primary selection criteria is overwhelmingly efficacy, and occaisionally cost or natural to fit S&C systems.

ANALYSIS

In general, the three most important factors for traditional developing country farmer pesticide selection are efficacy, price (cost) and availability. For a few select crops and products, the choice is made due to the fact that the pesticide is natural. But, more often, they do not consider factors that reduce risks to:

- Human health by using products that contain active ingredients with low acute human toxicity and few to no chronic health risks
- Scarce and valuable water resources on the surface and underground
- Biodiversity and environmental resources, and the services they provide, like those listed in Section 2.3, Table 2

By contrast, farmers supported by EGP implementation partners are being encouraged, by their use of S&C systems, to use less toxic and even organic products, which have lower human health and environmental risks. This is especially true in the blackberry and coffee sectors, both high value crops exported to the United States, which can be produced organically.

RECOMMENDATIONS FOR MITIGATION

- EGP staff will select the most suitable pesticides on the basis of reduced risk to applicators, reduced risk to environment resources, efficacy and price.
- During training courses, include training in pesticide selection factors, recommend in this report.
- EGP training, using material in this PERSUAP, material found in MSDSs, pesticide labels, and material found on pest management websites (like UC Davis IPM site), can emphasize the importance of these additional pesticide selection factors.
- EGP project staff economists perform economic analyses comparing pesticides to determine the most effective choice that is affordable, and has low health and environmental impact potential. Choose and use pesticides with low human and environmental risk profiles (see decision matrix in Annex 3, MSDSs, and Labels), as practical.
- EGP will aim to use more biological and naturally-derived pesticides, as practical, such as those listed in Annexes 8 and 9, including:
    - Commercial pyrethrum, a combination of natural chemicals called pyrethroids extracted from chrysanthemum flowers, provides good general pest control.
    - Extracts from neem trees are effective insecticides that are commercially available.
    - Spore extracts from the bacterium *Bacillus thuringiensis* are effective against worm or caterpillar larvae of moth and butterfly pests.
    - Insecticidal soaps and oils are effective against relatively sedentary pests like scales, mealybugs, aphids, and mites.

- Sulfur and copper compounds are effective plant disease controls.

Annex 3 contains these natural choices and their risks, and Annex 9 provides a list of botanical products studied and registered by EPA.

3.3 FACTOR C: EXTENT TO WHICH THE PROPOSED PESTICIDE USE IS, OR COULD BE, PART OF AN IPM PROGRAM

USAID promotes the training, development, and use of integrated approaches to pest management whenever possible. This section emphasizes how pesticides can be incorporated into an IPM strategy.

IPM TOOLS AND DISCUSSION OF RELEVANCE TO USAID/GUATEMALA: ISSUES, ANALYSIS, AND RECOMMENDED ACTIONS

Increasingly, GAP systems like those found being used in Guatemala for quality domestic and export crops incorporate certain IPM practices. This PERSUAP report recommends additional practices to adapt and adopt. The susceptibility of crop plants and trees to pests and diseases is greatly influenced by the general health of the plant or tree. Therefore, as emphasized above in Section 2.5, good crop management practices can strongly affect IPM, and good agronomic or cultural practices are the most basic and often the most important prerequisites for an effective IPM program. A healthy crop optimizes both capacity to prevent or tolerate pest damage while maintaining or increasing yield potential.

There are no biological control companies in Guatemala that produce and sell parasites and predators for pest control; however some parasites and pollinators are registered for import, and would likely be used in large commercial greenhouse settings. Several "natural" pesticides composed of living microbes or their extracts are also registered for import and use in Guatemala, including *Bacillus thuringiensis*, *Bacillus spaericus*, *Beauveria basiana*, and *Trichoderma* species.

Table 4 above shows and information in Annex 1 proves, even if redundantly, that every pesticide recommended can be used as part and parcel of an IPM program.

ANALYSIS OF GAP/IPM PRACTICES USED BY EGP-SUPPORTED FARMERS IN GUATEMALA

Table 5, below, summarizes the type of IPM practices used in Guatemala.

Table 5: GAP and IPM tools analyzed for use by Guatemala farmers

GAP/IPM Tools	Used in Guatemala by farmers on EGP projects?
Soil nutrient, texture and pH testing	Many small-scale producers have access to quality laboratory analyses via MOH, private and ANACAFE laboratories
Pest resistant/tolerant seed/plant variety	Yes, mostly certified hybrid seeds and cuttings.
Seed treatment with pesticides	Yes, for seed that requires it.
Soil moisture measurements	EGP implementation partners are providing some access to soil moisture measurements, could be increased.
Raised-bed production	Yes, somewhat common with vegetables
Drip irrigation with tested well water	EGP implementation partners are encouraging farm groups to collectively pay for costly wells, pumps, water analyses, pipes and drip irrigation equipment. Traditional farmers without access to these costly technologies use diversion of water from streams of questionable water quality and delivered by gravity.

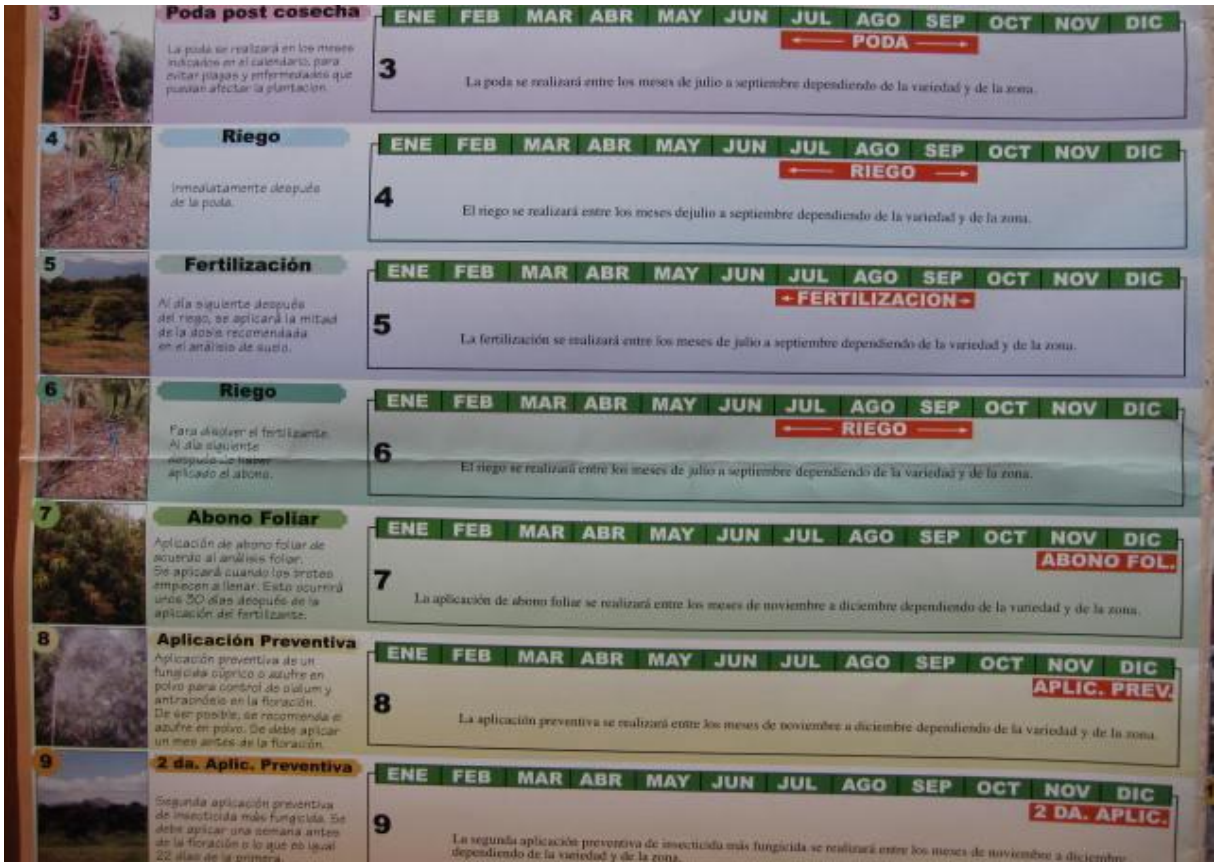
GAP/IPM Tools	Used in Guatemala by farmers on EGP projects?
Use of natural fertilizers (manure, compost)	Used by some EGP farmers; could be increased.
Use of purchased mineral fertilizers	NPK and urea commonly used, which are broadcasted by hand.
Combinations of organic and mineral fertilizers	Used by some EGP farmers; could be increased.
Crop rotation	Used by some EGP farmers; could be increased.
Use of green manure crops	Rarely used by farmers intent on continuous cultivation of crops.
Early/late plantings/harvestings to avoid pests	Uncommon.
Use of trap crops to trap and destroy pests	Uncommon.
Pruning and sanitation of diseased plants/trees	EGP encourages farmers to use sanitation; it is unknown the extent to which this occurs, with the few farms visited. Composting of diseased plants and crop waste could be encouraged and increased.
Planting parasite- and predator-attracting plants on field margins	Uncommon.
Farmer ability to correctly identify pests	Farmers know most pests by local names; in order to make and use accurate PMPs, scientific pest names are required for researching IPM practices used in other countries, and in the US intensive agriculture states of California and Florida for most of the same pest species.
Purchase and use of parasitoids to attack major pests	One species, *Trichogramma exiguum*, is registered by MAGA for import and use. None of EGP-supported farmers use this parasitoid, which attacks Heliothis larvae.
Use of pheromone or light traps to monitor moth or beetle levels	Common with Guatemalan farmers; could be promoted and used on more EGP-supported farms.
Use of pheromone or light traps to reduce overall moth or beetle levels	Pheromone traps used extensively in coffee sector for coffee borer, light traps in vegetables for adults of white soil grubs; both could be used by more GC-supported farms.
Use of pheromone inundation to confuse moth or beetle mating	Very uncommon in Guatemala and not used on EGP-supported farms; pheromone inundation technology likely unavailable.
Bi-weekly field scouting to assess pest levels/damage	Common on EGP-supported fields.
Farm use of a locked storage building for pesticides	Common on EGP-supported farms; need 100% coverage in future.
Ability of farmers to correctly identify predators, parasites and pest diseases	Limited.
Use of substances (like mix of brewer's yeast & molasses) to encourage predator/parasite build-up	None.
Mulching with organic materials or plastic to control weeds	Plastic mulch used in high-value strawberry culture both to control weeds and prevent fruit contact with soil; organic mulches for weed control are uncommon, and could be promoted.
Mechanical weed control by machine cultivation, hoe, or by hand, if plots are sufficiently small	Some machete weed control on organic coffee and hoe weed control on some vegetable farms; could be increased.

GAP/IPM Tools	Used in Guatemala by farmers on EGP projects?
Use of herbicides for weed control	Not common on EGP farms.
Exclude insect pests by using vegetable tunnels and micro-tunnels	Not common, expensive.
Mechanical insect control by hand picking larvae, pupae or adults	Not common on EGP farms; impractical for larger hectare farms.
Use of insecticides for insect control	Common.
Use of fungicides for control of fungus	Common.
Spot treatment of pest hotspots with insecticides, miticides or fungicides	Common.
Crop stalks, residue and dropped fruit destruction or composting at end of season	Coffee sector, cherry is composted, on vegetable farms residue is removed, but not composted.
Apply local artisanal plant extracts (neem, pyrethroid, garlic, chili peppers, other) to kill pests	Not common on EGP farms.
Any soil, water, energy, or biodiversity conservation practices?	Not common
Inter-planting crops with aromatic herbs (celery, cilantro, parsley) that repel pests?	Celery is planted near other crops for production, not for repellent properties.

In conclusion, many of the Guatemalan EGP beneficiary farmers, whether or not they understand the IPM philosophy fully, do know about, numerous GAP and IPM practices and use them.

RECOMMENDATIONS FOR MITIGATION

- Pesticides purchased or used under EGP should be selected on the basis of their compatibility with existing natural or Integrated Pest Management systems.
- EGP implementation partners assist with the production of crop and pest-specific PMPs organized by crop phenology or seasonality, and developed into field technical flyers or posters (see example of mango PMP poster from the Dominican Republic, below)
- During training and field visits by EGP implementing partners, enhance understanding of, and emphasis on, IPM philosophy, tools and practices, with synthetic pesticide use as a last resort and choice of least toxic alternatives
- EGP should investigate the use of additional GAP and IPM practices, listed above, and continue to follow international developments in IPM to identify new practices to apply in Guatemala.



Poster of Dominican Republic Mango GAP and PMP Poster for wall reference prediction & prevention

3.4 FACTOR D: PROPOSED METHOD OR METHODS OF APPLICATION, INCLUDING THE AVAILABILITY OF APPLICATION AND SAFETY EQUIPMENT

This section examines how pesticides are to be applied, to understand specific risks associated with application equipment methods, and the measures to be taken to ensure safe use for each application type.

Pesticides can and do enter the body through the nose and mouth as vapors, through the skin and eyes by leaky sprayers, mixing spillage/splashing and spray drift, and mouth by accidental splashing or ingestion on food or cigarettes.

ANALYSIS

Most recommended, as well as other, pesticides will be applied by hand-pumped backpack sprayers (see Table 4 above). For some tree crops, and a few other pesticides listed in the table above, like Amistar, Manzate, BT, Bellis and Iprodione, motorized backpack sprayers are used. Although most Guatemalan farmers do not use PPE, EGP-supported projects, as well as Agrequima, are promoting their use as a best practice and as a requirement for farm certification through one or more of the S&C systems.

ISSUE: LEAKY BACK-PACK SPRAYERS

Hand-pump backpack sprayers, used by the poorest farmers among others, can and do eventually develop leaks at almost every junction (filler cap, pump handle entry, exit hose attachment, lance attachment to the hose and at the lance handle), which soak into exposed skin. Clothing serves to wick and hold these pesticides in contact with skin, and to concentrate them use after use, until washed.

MITIGATION

EGP projects should include budget allocations for repair and maintenance of application equipment, and develop a management program that includes oversight of repair and maintenance.

ISSUE: GUATEMALAN FARM WORKERS DO NOT USE PPE

Many Guatemalan farm workers do not use PPE to reduce pesticide exposure risks because:

- Farmer workers either discredit or do not completely understand the potential health risks associated with pesticides. Since they have not associated health problems with pesticide exposure they continue to take risks. Climatic conditions (particularly heat) make it uncomfortable to use the equipment, despite the fact that it is recommended that many pesticides should be applied very early in the morning when it is cool and there is little or no wind.

- Appropriate PPE, especially carbon cartridge respirators necessary for filtering organic chemical vapors, is generally not available; if it is available, it is very expensive.

- Farmers may not understand either the warning labels or pictograms provided on the pesticide labels.

Standards and certification systems for trade in agricultural commodities also require the use of appropriate PPE. ***Nevertheless, GlobalGAP-certified EGP farmers do use PPE by requirement***. Most pesticide containers, on each pesticide label, either list or put pictograms showing PPE that is recommended for use of that certain product.

MITIGATION

1. Training under EGP should include descriptions of health risks to spray operators, their families, and their village.

2. Training should include advice on minimizing discomfort from wearing PPE.

3. USAID should not supply or facilitate the use of pesticides in EGP unless appropriate PPE is included in the budget and supplied at the point of use.

4. Ensure that training materials are understandable to all audiences.

SUMMARY OF MITIGATION RECOMMENDATIONS

- Ensure that funds are appropriated to purchase protective clothing for project farmers. Such PPE should include carbon-filter respirator masks, gloves, long-sleeved shirt and pants or Tyvec outfit, boots, and goggles if indicated on the label). General examples of PPE to be used for different types of pesticide are found in Annex 11.

- In training and awareness sessions, include specific parameters regarding exclusion times and zones for areas that are being or have been sprayed.

- Provide information about sensitive populations (pregnant women, children, elderly, sick).

- Establish sprayer equipment maintenance procedures and schedules, proper spray techniques that reduce sprayed area walk-through, as well as frequent washing of application clothing.
- Considering illiteracy issues, training should use and explain pictogram representations. General mitigation measures to ensure safe pesticide use are contained in Annex 10.
- Establish continuous training in safe handling and use of pesticides, including aspects such as types and classes of pesticides, human and environmental risk associated with pesticides, use and maintenance of PPE, understanding information on labels and proper disposal of packaging.

3.5 FACTOR E: ANY ACUTE AND LONG-TERM TOXICOLOGICAL HAZARDS, EITHER HUMAN OR ENVIRONMENTAL, ASSOCIATED WITH THE PROPOSED USE, AND MEASURES AVAILABLE TO MINIMIZE SUCH HAZARDS

This section of the PERSUAP examines the acute and chronic toxicological risks associated with the proposed pesticides.

ANALYSES

The pesticide matrix in Annex 3 contains information on acute and chronic human and environmental toxicological risks for every pesticide AI registered by MAGA. ***USAID-supported projects must be limited to EPA-registered pesticides, and decisions should be biased toward those pesticides with lower human and environmental risks.*** Nevertheless, pesticides are poisons, and nearly all of them present acute and/or long-term toxicological hazards, especially if they are used incorrectly.

The WHO estimates that about 220,000 acute pesticide poisoning occur per year globally.[15] Although there are reports of pesticide poisonings throughout the traditional agriculture systems in Guatemala, S&C systems in place on EGP project farms reduce these risks.

Almost all pesticides, including those from natural sources, have some environmental impacts and have both potentially acute (if a sufficiently high dosage is encountered) and chronic human health impacts. For the recommended pesticides found in Table 4 under Factor A, above, all known carcinogens, POPs, PIC and RUP chemicals and Class I chemicals have been removed. Some remaining chemicals do have potential or possible chronic issues—these are very difficult to avoid. The way to deal with them is to ensure that farmers use PPE every time they apply pesticides, or they implicitly accept and assume the associated potential long-term risks.

ISSUE: PESTICIDE ACTIVE INGREDIENTS ON POPS AND PIC LISTS

The POPs and PIC lists of banned and highly regulated chemicals, respectively, were not known when Regulation 216 was written, so there is no language directly governing their use on USAID projects. They do, however, present high risks to users and the environment. It is thus prudent that they be discussed.

According to crop protection officials, there are likely no significant quantities of POPs chemicals in use in Guatemala. As for PIC chemicals, MAGA's 2009 registered pesticide list contains only one remaining PIC insecticide AI, phosphamidon (in addition to recently-banned methamidophos). Crop protection experts questioned indicated that it is improbable to find other PIC chemicals being imported into and used in Guatemala, and that their entry as contraband from surrounding countries is unlikely as other countries are finding PIC chemicals rare. That said, methamidophos can still be found in farm stores,

[15] http://magazine.panna.org/spring2006/inDepthGlobalPoisoning.html

and will likely take 2-3 years to completely clear the retail system. ***For several reasons, including human toxicity and environmental risks, no POP or PIC chemicals should be used on EGP projects.***

ISSUE: VERY HIGH ACUTE TOXICITY

Several of the pesticides found with pesticide distributors and in rural farm stores in Guatemala, contain active ingredients that are *too toxic for small-scale (USAID's target), unaware and uninformed farmers to use.* These very highly acutely toxic pesticide AIs are found in Annex 5. Less toxic alternatives exist for all of these Class I chemicals.

MITIGATION

With the exception of rodenticides, EGP's beneficiaries may not use products containing these active ingredients that are WHO Class 1a or 1b, or EPA Class I acute toxicity.

ISSUE: MODERATE ACUTE TOXICITY

All pesticide products that have at least acute WHO and EPA toxicity ratings of II (see Annex 3) are considered to be too toxic for use without farmer training and proper use of PPE.

MITIGATION

Products containing active ingredients with Class II acute toxicity ratings (see Annex 3) should not be recommended unless there are no safer effective alternatives (Class III or IV). Moreover, recommendations should not be made to use such products unless it can be ascertained that appropriate training and PPE are available *and will be used.* Affordable PPE should be made available to farmers either through the local retail sector, or if not available, sourced in quantity by EGP implementers and sold or subsidized for their beneficiary farm associations. Certified farms already have sufficient PPE. Additional associations not yet certified can continue be encouraged to share PPE among their members.

ISSUE: EGP USE OF LOWER TOXICITY PESTICIDES REGISTERED BY EPA

Even EPA Class III and IV and WHO Class III pesticides, as well as General Use Pesticides (GUP) sold to the public at large, may present acute and chronic human health and environmental risks (see decision matrix in Annex 3). In sufficiently high doses, they may kill or harm humans or the environment. Pesticide safe use and handling training and practice are required for their use as well as for more toxic products.

MITIGATION OF HUMAN TOXICOLOGICAL EXPOSURES

Most pesticide poisonings result from careless handling practices or from a lack of knowledge regarding the safer handling of pesticides. Pesticides can enter the body in four major ways: through the skin, the mouth, the nose, and the eyes. A table and checklist are given below to help avoid these various routes of overexposure to pesticides. Annex 12 contains measures to reduce risks of exposure via oral, dermal, respiratory, and eyes. The time spent learning about safer procedures and how to use them is an investment in the health and safety of oneself, one's family, and others.

- EGP should encourage beneficiaries to source pesticides from well-managed stores that do not sell banned (like methomidophos) or products containing very highly toxic active ingredients and receive safe use and handling training, and monitoring of use.

- Train producers and provide posters/flyers on pesticide safe-use BMPs. For each group or of farmers/farm managers to be trained, identify the pesticides most likely to be used on their specific crops, and then identify the human health risks associated with each by using information on pesticide labels, in the attached Annex 3, and on MSDSs.

- Provide training on, and follow basic first aid for, pesticide overexposure. Train farm managers and farmers on basic pesticide overexposure first aid, while following recommendations found in Annex 13, as well as any special first aid information included on labels and MSDSs for commonly-used pesticides.
- Avoid negative impacts to the environment through training on recognizing and avoiding non-target impacts. For pesticides likely to be used for each crop, identify specific environmental issues associated with each product and AI and train farmers how to identify and mitigate such risks by learning to "read" the safety pictograms contained on the label and MSDS. Information on environmental risks for each AI registered by MAGA is compiled in Annex 3.

MITIGATION OF EXPOSURES TO ENVIRONMENTAL RESOURCES

Ecotoxicological exposures can be mitigated by adhering to the following do's and don'ts:

Do

- ✓ Use IPM practices in crop production
- ✓ Choose the pesticide least toxic to fish and wildlife
- ✓ Protect field borders, bodies of water, and other non-crop habitats from pesticide
- ✓ Completely cover pesticide granules with soil, especially spilled granules at the ends of rows
- ✓ Minimize chemical spray drift by using low-pressure sprays and nozzles that produce large droplets, properly calibrating and maintaining spray equipment, and use of a drift-control agent
- ✓ Read and follow pesticide label instructions
- ✓ Properly dispose of chemical containers (provide training on what this means locally)
- ✓ Maintain a 2.5 to 5 km buffer no-spray zone around national parks, water bodies or other protected areas
- ✓ Warn beekeepers of upcoming spray events so that they may move or protect their hives

Don't

- ✓ Do not spray over ponds and drainage ditches
- ✓ Never wash equipment or containers in streams or where rinse water could enter ponds or streams
- ✓ Do not use pesticides with potential or known groundwater risks near ground drinking water sources, or where the water table is less than 2 meters, and on sandy soils with high water tables
- ✓ Do not apply pesticides in protected parks
- ✓ Do not use aerial applications near sensitive habitats
- ✓ Do not spray when wind speeds are more than 8 to 10 mph
- ✓ Do not apply granular pesticides in fields known to be frequented by migratory waterfowl
- ✓ Do not apply insecticides from 10 am to 4 pm when honeybees are foraging; insecticides are best applied early in the morning when it is cool with no wind, and when honeybees do not forage

3.6 FACTOR F: EFFECTIVENESS OF THE REQUESTED PESTICIDE FOR THE PROPOSED USE

This section of the PERSUAP provides more specific information regarding actual conditions of application, product quality, and the potential for use of low-quality products as well as the development of pest resistance to proposed pesticides both of which will decrease effectiveness.

ANALYSIS

Local knowledge is essential for choosing the correct pesticides. This works both ways: local farmers know what has or has not worked for them in the past, and EGP programs can increase local knowledge about what is available that may be more effective, while presenting lowest risk.

Resistance of pests to pesticides in Guatemala is likely in some degree due to the quantities of agricultural pesticides used. Many traditional farmers over- and under-dose and use non-selective pesticides, all of which increases chances for resistance development. At some point, EGP farmers may begin to note that some products no longer work well to control pests in their field, and will likely begin to blame pesticide manufacturers for a weaker product. This could be the development of insecticide resistance, as a result of improper dosing. Farmers should be trained to monitor for the development of insecticide resistance, and EGP project implementers should be on the lookout for it during their field visits.

As Table 4 under Factor A, above, shows, all recommended pesticides are considered effective. There is evidence that some chemicals, especially extensively-used synthetic pyrethroids, are showing some signs of resistance development. The ways to avoid this are detailed below.

MITIGATION RECOMMENDATIONS

- Rotate pesticides to reduce the build-up of resistance
- Monitor resistance by noting reduction in efficacy of each pesticide product

3.7 FACTOR G: COMPATIBILITY OF THE PROPOSED PESTICIDE USE WITH TARGET AND NON-TARGET ECOSYSTEMS.

This section examines the potential effect of the pesticides on organisms other than the target pest. Non-target species of concern include fish, honeybees, birds, earthworms, aquatic organisms, and beneficial insects. The potential for negative impact on non-target species should be assessed and appropriate steps identified to mitigate adverse impacts. The mitigation measures should be included in the EMMP and reassessed annually

ANALYSES

As Table 4, above, shows, many pesticides, including some from natural sources and even some used in organic systems—for instance neem oil and bacterial extract avermectin (Vertimec), do have relative environmental toxicities—they are unavoidable. For instance, most chemicals known have some degree of aquatic toxicity, and if gotten into water in sufficiently large quantities (which are unlikely with the quantities applied in the field in Guatemala) due to an accidental spill directly from a pesticide container, could impact aquatic resources.

Risk is strongly impacted by the relative amounts of chemicals that make their way to natural resources and at-risk organisms. All pesticides need to be used in recommended doses and uses, and not gotten into water. Pesticide lables contain this information and need to be read by farmers before application.

Annex 3 shows the relative known risks to fish, honeybees, birds, earthworms, aquatic organisms, and beneficial insects and aquatic environment dwellers for each pesticide active ingredient found in pesticide products registered by MAGA, This information allows producers to make informed choices should the pesticide be used in or near sensitive areas or resources. In addition, Table 2 in Section 2.3 shows the environmental services provided by many of these organisms that can be affected by pesticides.

ISSUE: BIODIVERSITY, CONSERVATION, AND PROTECTED OR ENDANGERED SPECIES

Guatemala has 7,754 plant species, 155 of which are endemic. In addition, there are 651 fish species, 112 amphibians (28 endemic), 214 reptiles (18 endemic), 738 bird species (1 endemic), and 251 species (3 endemic) of mammals. Approximately 20% of the Guatemalan avian fauna is composed of migrant species. Guatemala is a critical destination or stop-over area for approximately 184 migrant and 24 stop-over species between the North and South American continents, along narrow routes of travel that converge over the Central American isthmus. With such varied and unique biodiversity, rational use and handling of pesticides is even more critical.

According to the 2003 Tropical Forestry and Biodiversity Assessment, "Environmental contamination and degradation, caused by air, water and soil pollution, represent major threats to Guatemala's biodiversity and tropical forests. Impacts are caused by sewage discharges into aquatic and terrestrial systems, runoff of *misapplied fertilizers and other agricultural control products*, gases released by industrial processes and the changes in land use, especially in the elimination of forest cover to agricultural lands.

Approximately 70% of the water supply for Guatemala's 331 municipalities comes from surface water. In the Motagua River watershed and in Lake Amatitlán, organochlorates were observed in levels above 0.56 ug/l for a range of 37 reported *herbicides and insecticides*, of which 15 were prohibited for use in Guatemala since 1988.[16] The southern coastal region has higher levels of *herbicides and insecticides* in the surface water than the northeastern region. The Villalobos River, which drains Amatitlan Lake, is one of the country's most polluted rivers due to high levels of household and garden chemicals, and above all, from *herbicides and insecticides* that are used in the agriculture areas under intense farming, in the small watershed of the Platanitos River."

[16] Environmental Monitoring Project. 2000. Water quality study in the watershed of the Motagua and Polochic Rivers. CATIE-USAID. Guatemala, 48 p.

Table 6: Protected Areas System in Guatemala

Categories (a)	Number (b)	Area (ha)	(%)
Category I: Biological and ecological reserves, Biotopes (c)	7	26,488	0.83
Category II: National Parks (terrestrial or marine), Regional Park (d)	26	59,802	1.87
Category III: Natural Monument, Cultural Monument, Historic Park, Natural and Cultural Monument	5	6,399	0.20
Category IV: Forestry Reserves, Prohibited Hunting Zones, Wild Life Refuges, Protected Springs, Private Natural Reserves	77	236,278.85	7.39
Category VI: Biosphere Reserve, Multiple Use Zones	8	1,918,096	60.03
Buffer Zones (e)		948,341	
TOTAL (f)	**123**	**3,112,913.6**	**100.00**

References:

(a) No protected areas have been formally decreed in Category V (Scenic Routes and National Recreational Areas)
(b) Total considering independent conservation units. If the Maya Biosphere Reserve is considered as a discrete unit, then the total is reduced to 116.
(c) Category I: the area of Laguna del Tigre, Dos Lagunas, and San Miguel La Palotada Biotopes, is accounted for within the Maya Biosphere Reserve.
(d) Category II: the area of Sierra del Lacandon, Laguna del Tigre, Tikal, and Mirador Rio Azul National Parks is accounted for within the MBR.
(e) Consolidated area of the Zonas de Veda (volcanoes), MBR, San Roman, El Pucte, Chiquibul Montanas Mayas, Xutilja, Sierra de las Minas and Cerro San Gil Buffer Zones.

The total area is estimated, since there are overlaps between some natural private reserves within larger areas previously declared as other protected categories. However, the error associated with this estimate is not more than 1%.

Protected or Endangered Species: As a result of the threats to the biodiversity and tropical forests, Guatemala has two globally recognized and critically endangered ecoregions, three endangered forest ecosystems that are important for the country's development, as well as more than 300 threatened and endangered species of flora and fauna registered in CITES.

ISSUE: PESTICIDE PERSISTENCE

The effect of each pesticide on non-target ecosystems will depend on how long it stays in the environment, or rather its rate of break-down, or half-life. Half-life is defined as the time (in days, weeks or years) required for half of the pesticide present after an application to break down into degradation products. The rate of pesticide breakdown depends on a variety of factors including temperature, soil pH, soil microbe content, and whether or not the pesticide is exposed to light, water, and oxygen.

Many pesticide breakdown products are themselves toxic, and each may also have a significant half-life. Since pesticides break down with exposure to soil microbes and natural chemicals, sunlight and water, there are half-lives for exposure to each of these factors. In the soil, types and numbers of microbes present, water, oxygen, temperature, pH, and soil type (sand, clay, loam) all affect the rate of breakdown.

Most pesticides also break down, or photo-degrade, with exposure to light, especially ultraviolet rays. Lastly, pesticides can be broken down, or hydrolyzed, with exposure to water.

MITIGATION RECOMMENDATIONS

- Consider the toxicity, half-life, and breakdown products of pesticides during the selection process.
- Avoid using pesticides in or within a 2km buffer zone from protected areas or national parks and where endangered species are known to exist.
- If agricultural production is done within 10km up-wind or up-stream from a protected area, investigate the use of botanical and biological controls, as practical, or produce organic crops near these valuable natural resources.
- Apply pesticides early in the morning before honeybees forage. Do not apply during heavy rains or winds. Follow instructions on pesticide packaging.
- Apply pesticides at least 35 meters from open water.

3.8 FACTOR H: CONDITIONS UNDER WHICH THE PESTICIDE IS TO BE USED, INCLUDING CLIMATE, GEOGRAPHY, HYDROLOGY, AND SOILS

In general, in addition to factor G above, this requirement identifies ways to protect natural resources from the dangers of pesticide misuse and contamination, especially of groundwater resources.

Table 4 has eliminated all chemicals that are known groundwater pollutants; some recommended chemicals are potential pollutants due to their relative lack of ability to bind tightly to soil particles. These need to be used with care in sandy soils with high groundwater tables, such as those found along the coast. Most EGP projects are located in-land, far from the coasts.

CLIMATE

The climate of Guatemala is hot and humid in the lowlands and cooler and dryer as altitude increases into the mountains. The mean total rainfall is 1186mm, and the mean temperatures (minimum/ maximum) are 14.7/25.0 °C. Crops grown in the warmer and more humid lowlands will generally be prone to more plant diseases and insect pests, whereas pest numbers and crop damage decrease with altitude and decreasing temperature and humidity. All of the farms visited were at high altitude, with fewer pest problems than would be found at lower altitudes.

GEOGRAPHY

The geography of Guatemala was discussed, above, in Section 2.1. Guatemala is mostly mountainous with a string of volcanoes running from narrow coastal plains and rolling limestone plateau.

HYDROLOGY

As noted above under Factor G, approximately 70% of water supply for the 331 municipalities of Guatemala is derived from surface water, such as rivers and lakes. Much of this is polluted by herbicides and other pesticides.

SOILS

Upland soils are relatively young volcanic Andisols, deep and rich in minerals, but with fixed (unavailable) phosphorous, whereas lowland soils near the coast, where sugarcane predominates, are a mix of volcanic phosphorous-deficient Andisols, productive grassland loess- and limestone-derived Mollisols and little-developed Entisols. Northern Guatemala jungle and hillside soils are Haprendolls,

Argiudolls, and Hapludolls, containing generally high proportions of sand and silt and lower proportions of clay[17].

ISSUE: PESTICIDE SOIL ADSORPTION, LEACHING AND WATER CONTAMINATION POTENTIALS

Each pesticide has physical characteristics, such as solubility in water, ability to bind to soil particles and be held (adsorbed) by soil so they do not enter the soil water layers, the ground water table, as well as their natural breakdown rate in nature. This data can be found for the pesticides proposed for use on the EGP project by checking each pesticide on the Pesticide Action Network (PAN) and Footprint websites: http://www.pesticideinfo.org and http://sitem.herts.ac.uk/aeru/footprint/en/index.htm, respectively. The water solubility, soil adsorption, and natural breakdown rates, if available, are included at the bottom of the PAN webpage and throughout the Footprint webpage, for each parent chemical.

In general, pesticides with the following characteristics have the potential to contaminate groundwater:

- water solubility greater than 3 mg/liter
- a soil adsorption coefficient of less than 1,900
- an aerobic soil half-life greater than 690 days or an anaerobic soil half-life greater than nine days
- a hydrolysis half-life greater than 14 days

The potential for pesticides to enter groundwater resources depends, as indicated above, on the electrical charge contained on a pesticide molecule and its ability and propensity to adhere to soil particles, but this also depends on the nature and charge of the soil particles dominant in the agriculture production area. Sand, clay, and organic matter, and different combinations of all of these, have different charges and adhesion potential for organic and inorganic molecules. Sandy soil often has less charge capacity than clay or organic matter, and will thus not interact significantly with and hold charged pesticide molecules. So, in areas with sandy soil, the leaching potential for pesticides is increased.

A pesticide's ability to enter groundwater resources also depends on how quickly and by what means it is broken down and the distance (and thus time) it has to travel to the groundwater. If the groundwater table is high, the risk that the pesticide will enter it before being broken down is increased. Thus, a sandy soil with a high water table is the most risky situation for groundwater contamination by pesticides. Groundwater contamination potential for each pesticide active ingredient available in Guatemala is provided in Annex 3.

MITIGATION RECOMMENDATIONS

- Since transport of pesticides absorbed to soil particles is a likely transportation route to waterways, techniques should be employed to reduce farm soil erosion such as terracing, employing ground covers between rows, planting rows perpendicular to the slope, using drip irrigation, etc.
- Do not use herbicides or other pesticides with high leaching and groundwater pollution potential (see Annex 3) on highly sandy soils or soils with water tables close (2-3 meters) to the surface. Use particular care when spraying near waterways, so that pesticides do not enter surface water.
- Do not spray synthetic pyrethroid or other pesticides with high toxicities to aquatic organisms before an impending rainstorm, as they can be washed into waterways before breaking down.

[17] http://soil.scijournals.org/cgi/reprint/69/6/2020.pdf

3.9 FACTOR I: AVAILABILITY OF OTHER PESTICIDES OR NON-CHEMICAL CONTROL METHODS

This section identifies less toxic, as well as non-synthetic or "natural" (extracts of naturally-occurring plants, spices, oils, fatty acids, induced resistance elicitors, minerals, microbes or microbial extracts) pesticide options for control of pests and their relative advantages and disadvantages. Many of these "natural" pesticides can be toxic to humans, and several are even classified as RUP due to environmental risks; thus safe pesticide use practices extend to these natural as well as synthetic (produced in laboratories or factories) pesticides.

Table 4 compiles from Annex 1, even if redundantly, that there are a plethora of other pesticide and non-chemical controls available for Guatemalan farmers to use.

ANALYSIS

Natural chemicals: Non-synthetic chemical IPM tools and technologies are listed under Factor C, above. The list of natural pesticides likely entering Guatemala is extensive (see Annex 3 and Annex 8, Natural Pesticides), thus there are numerous options for alternatives to the most toxic or environmentally damaging chemicals. Most synthetic nematocides and soil pesticides are very highly toxic. Therefore it is especially important that two new biological nematocides (listed in Annex 8) can replace these very highly toxic synthetic nematocides, at reduced risks.

Biological control agents: Biological control can take two forms:

1. The encouragement of natural enemies already occurring in the habitat
2. The mass release of artificially reared natural enemies

The first of these is a highly desirable component of any IPM program. The second, however, raises serious problems, if not tested thoroughly. A mistaken release can cause the irreversible introduction of a harmful invasive species or a pathogen that damages related native species. Where there is a successful biological control program in the region (Mexico, Nicaragua, Honduras or El Salvador), such as the control of maize stem borers, the release of a natural enemy can be considered.

If considered appropriate for Guatemala, due to their successful use in surrounding countries, or in Guatemala, biological controls for larger commercial operations – especially greenhouses – are available commercially from two large international companies, Koppert of Holland and Biobest of Belgium. Koppert provides many biological controls against spider mites, beetles, leaf miners, mealy bugs, thrips, aphids, whiteflies, and moth and butterfly larvae. Koppert also provides the Koppert Side Effects List, a list of the side effects of pesticides on biological organisms, at http://www.koppert.com. Biobest of Belgium (http://www.biobest.be) provides many of the same or similar biological controls as Koppert, and includes a control against leaf hoppers. Agricola Popoyán is a distributor in Guatemala for Koppert parasitoids, primarily for greenhouse use.

Anacafé has a production facility that produces micro hymenoptera biological control for use against the coffee borer. This parasitoid is promoted to Anacafé associates as part of a coffee IPM program. Agricola el Sol produces *Beauveria bassiana* and Nuclear Poliedrosis Virus (NPV) commercially for Guatemalan markets. Additionally, in the sugar industry sector, Ingenio Pantaleon and Ingenio Magdalena have laboratories for the production of arasitoids for use against sugarcane borer, *Diatraea saccharalis*.

MITIGATION RECOMMENDATIONS

- As appropriate, try biological and low-risk natural chemical pest controls.

- Provide a system for monitoring and identifying new control agents with lower risk.
- As with every synthetic pesticide, natural pesticides should be treated with care and PPE should be used for their application.

3.10 FACTOR J: HOST COUNTRY'S ABILITY TO REGULATE OR CONTROL THE DISTRIBUTION, STORAGE, USE, AND DISPOSAL OF THE REQUESTED PESTICIDE

This section examines the host country's existing infrastructure and human resources for managing the use of the proposed pesticides. If the host country's ability to regulate pesticides is inadequate, the proposed action – use of pesticides – could result in greater risk to human health and the environment.

Table 4 reveals, even if redundantly, that MAGA does have written regulations for pesticide use and a system for registering pesticides; however resources for enforcement are lacking, thus regulation abilities are weak.

ISSUE: LIMITED RESOURCES TO CONTROL PESTICIDES

The Government of Guatemala does have a system for the registration and regulation of the import, sale, and use of pesticides. However, its ability to cover the country and eliminate banned or highly toxic chemicals is limited due to lack of financial and resources. The list of registered pesticides is exceptionally long and contains some very highly toxic chemicals that should not be handled by illiterate, untrained, unprotected, and often unaware small farmers like those found throughout Guatemala. Most farmers do not have access to and cannot afford PPE in order to follow GAPs. Fortunately, farmers working under EGP projects partners are being encouraged to use appropriate chemicals and PPE as part and parcel of farm certification.

ISSUE: ILLEGAL PRODUCTS FROM NEIGHBORING COUNTRIES

Porous border crossings with Mexico, Honduras, El Salvador and Belize present a likely source of pesticides that are not registered in Guatemala. For example, the PIC chemical Methomidophos was only banned in 2009 in Guatemala – for export market, not safety, reasons. POPs chemicals are largely unavailable in Guatemala according to MAGA. Current PIC and POPs lists are on Annex 14.

ISSUE: DISPOSAL OF PESTICIDE CONTAINERS

In spite of the Agrequima initiative to collect and recycle empty plastic pesticide containers, the message needs to reach more farmers. Some of the farmers interviewed for this study retained old empty and partially-full plastic pesticide containers (but were informed of the recycling initiative). Before recycling, the standard practice was to triple-rinse the containers, puncture them to discourage re-use, and bury or burn them. Burning plastic bottles and single-use sachets can lead to the formation of toxic furans and dioxins, and is not recommended. GlobalGAP and other S&C systems require that empty pesticide containers are triple rinsed over a pesticide soak pit with layered soil, lime, and carbon, or a bio-active pit, and then properly stored in plastic drums in the field or storage shed, to await disposal. Annex 15 of this document provides pesticide disposal options.

MITIGATION RECOMMENDATIONS

- EGP staff can continue to work closely with the MAGA to stay abreast of developments in the regulation and registration of pesticides.
- Absolutely no POPs or PIC chemicals should be used on EGP-supported fruit and vegetable production. This includes endosulfan, a POPs Treaty candidate, which is highly popular among vegetable producers the world over, but has killed numerous farmers.

- EGP partners continue to encourage and support the use of GlobalGAP best practices with pesticide storage, use, and disposal, whether or not certification is required for market access.
- EGP partners encourage their beneficiaries to use the Agrequima triple rinse followed by pesticide container recycling facilities, instead of burying or burning containers.

3.11 FACTOR K: PROVISION FOR TRAINING OF USERS AND APPLICATORS

USAID recognizes that safety training is an essential component in programs involving the use of pesticides. The need for thorough training is particularly important in developing countries, where the level of education of applicators may typically be lower than in developed countries.

Table 4 compiles, even if redundantly, that there are training options being offered by each EGP project being implemented.

ANALYSIS

Training in Safe Pesticide Use and GAP/IPM are of paramount importance for Guatemalan farmers and farm laborers using pesticides. Fortunately, USAID EGP-supported agriculture activities focus strongly on providing GAP, IPM, and safe pesticide use training. Additional and refresher training are superb means for helping change beneficiary farmer behavior, as they continue to expand their agricultural opportunities, and before risky behaviors become further set.

MITIGATION RECOMMENDATIONS

- Continue to provide funding for and implement IPM and Pesticide Safe Use training for farmers as part of GAP training.
- Promote the use of Pest Management Plans for farmers to anticipate and better manage primary pests.

3.12 FACTOR L: PROVISION MADE FOR MONITORING THE USE AND EFFECTIVENESS OF EACH PESTICIDE

Evaluating the risks and benefits of pesticide use should be an ongoing, dynamic process. Pest resistance is one of the risks for which this element is intended, as well as health and safety and environmental effects.

Table 4 compiles, even if redundantly, that there are monitoring options being implemented by each EGP project's staff.

ANALYSES

Proper pesticide management has economic, safety and environmental advantages, which are fully recognized and incorporated into GlobalGAP and other S&C systems. Notwithstanding S&C systems that could be used for Guatemalan crops, keeping records on quantities and types of pesticides used, making notes on effectiveness of individual pesticides and pest numbers will help develop a more sustainable pesticide use plan for each EGP beneficiary producer.

In addition, many of the EGP project partners are either already meeting, or in the process of meeting HortiFruti and Wal-Mart food quality standards for local consumption, as well as GlobalGAP, Organic and US Food and Drug Administration (FDA) standards for export, and in doing so will need to greatly improve their inventory and other pesticide documentation standards, especially for chemicals used,

amounts used, date used and MRLs.[18] Records of farmers, as well as EGP staff agronomists, will need to make note of any reductions in pesticide efficacy experienced, which is the first indication that resistance may be developing, and then a strategy needs to be in place to determine a shift to a different pesticide class, and rotation among classes, to overcome resistance development.

Both carbamate and organophospate pesticides cause cholinesterase inhibition upon exposure. In the case of carbamates, the effect is reversible within hours, and is not cumulative. However, with organophosphates, the effects are not quickly reversible, are cumulative, and are potentially deadly. Therefore, ***the use of organophosphate pesticides on any USAID-funded program requires monitoring spray operators and others in contact with pesticides for cholinesterase inhibition, usually weekly***. If organophosphates are used, a system must be established for this testing, including identifying and appropriate test method, identifying medical personnel qualified to perform the test, and establishment of a record-keeping system to record the performance of the tests, as well as the results.

ISSUE: FARM RECORD-KEEPING

On most traditional farms in Guatemala, pesticide use documentation is either non-existent or not retained from year to year. Developing a more systemized approach to record keeping will allow seasonal and annual comparison of pesticide effectiveness, pest numbers, crop production, maintenance of safety equipment, and so on. EGP beneficiaries are in the process of becoming certified for either Wal-Mart, GlobalGAP, or Organic, all of which require that accurate farm records are kept. The following aspects are generally included in the record keeping system:

- **Guatemala, EPA, and EU regulatory compliance:** A list of Guatemalan, EPA, and EU laws related to the use of agrochemicals for plant protection, short notes on the relevance of the law, dates the laws come into or exit force, and MRLs for each crop-pesticide combination.
- **A pesticide checklist:** This list allows agronomists to ensure that the pesticides they are using are allowed by international treaties (POPs, PIC), local national Guatemalan regulations, USEPA, the EU and other countries to which they export. It should also provide notes on special safety requirements.
- **GAPs/IPM measures tried/used:** EGP agronomists should try to incorporate a minimum of at least three new IPM measures per annum and document its success or failure. Agronomists should use contacts in the industry, agricultural research organizations or from university to stay in touch with current IPM techniques.
- **PPE:** Lists of the types of equipment made available to applicators, number of pieces, prices and contact details of suppliers, dates when equipment needs to be washed, maintained or replaced. PPE should be numbered or personally assigned to applicators to ensure that it is not taken home where (as a contaminated material) it could pose a risk to family members.
- **Monitoring/recording pests:** Agronomists should incorporate regular field pest monitoring and identification into their records. This could be done by the agronomists themselves or, if they are properly trained, by farmers.
- **Environmental conditions:** Field conditions should be incorporated into the record keeping system (for example: precipitation, soil analyses and moisture, soil pH, temperatures, etc.).

[18] **Title 40: Protection of Environment:** http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?type=simple&c=ecfr&cc=ecfr&sid=aa60e99ba71580c37baf05cdd5a07cce&idno=40&region=DIV1&q1=cucumber&rgn=Full+text

Information should be transmitted at least annually to EGP, and EGP should report on this progress in pesticide safety and GAP/IPM use in annual reports.

ISSUE: MONITORING BY MAGA, EGP, AND FARMERS

Monitoring conducted by the government of Guatemala, EGP implementers, and farmers should be designed to detect the following pesticide issues.

- Resistance: Pesticide resistance development among pests has likely occurred and could eventually occur more, and will be noted by farmers complaining that the spray no longer works as it once did.
- Human poisoning and any incidences of chronic health issues.
- Farm animal and livestock deaths.
- Any incidences of water pollution.
- Fish, bird, wildlife or honeybee kills.

Any of the above items should be reported immediately to EGP. Other information should be transmitted at least annually to EGP, and EGP should report on this progress in pesticide environmental and human health safety in annual reports.

ISSUE: EGP PLANNING AND REPORTING

Several issues could receive more attention in EGP Implementing Partner annual work plans and annual reports. These include a section on Environmental Impact Mitigation and Best Practices that discusses progress and issues related to:

- Guatemalan and EPA regulation compliance (documents and enforcement status, risk, pollution, mitigation)
- GAPs/IPM measures tried/used and on what percent of EGP farms
- Biodiversity and conservation (soil, water, energy, protected habitats, biodiversity and protected species) measures used on what percent of farms
- Inputs and PPE use and issues (types, amounts and issues with products, sprayers, MRLs, REIs, MSDSs)
- Training/capacity building in IPM and Safe Use (learning-by-doing , demos, sessions, meetings, extension, flyers, brochures, pamphlets, posters, crop technical GAP information sheets, and radio and TV outreach/safety message enforcement)

ISSUE: TRACEABILITY AND STANDARD OPERATING PROCEDURES (SOPS) FOR DETECTING PESTICIDE POISONING

Chain of custody systems are currently being developed to trace produce back from the export retail market to individual farms or farm groupings. However, there are no Standard Operating Procedures for detecting human poisoning and incidences of chronic health issues, or livestock fish, bird, wildlife or honeybee kills.

MITIGATION RECOMMENDATIONS

- EGP implementers and farmers should follow all of the above best practices in monitoring, record-keeping, evaluation/analyses, and reporting.

- Site managers/agronomists should develop a record-keeping system, that meets the requirement for GlobalGAP and other international market-driven produce certification systems. Site managers/agronomists will be responsible for developing a record keeping system. It is highly recommended that records be kept in an electronic format for easy editing, updating, and modification. An example of such a system is included in Annex 16 and can be made available in digital format for agronomists to modify as needed.

- EGP staff should incorporate monitoring plans for environmental and human health impact of production activities into the Annual Action Plans.

- EGP project staff should keeps records on the implementation of the recommendations found in this PERSUAP, and report on them in quarterly and annual reports, under a heading titled "Environmental Impact Mitigation and Best Practices."

SECTION 4. PESTICIDE SAFE USE ACTION PLAN FOR EGP IMPLEMENTATION PARTNERS

Action Plan Title: Actions to Increase Awareness of and Mitigate Pesticide Risks on EGP Implementation Partners Project Sites

Action Plan Objectives: Reduce risks from pesticides used for agricultural production and increase IPM knowledge

On the following Action Plan Matrix, insert the start and end dates for each activity or action with the names of those responsible for each action. Once this is action plan is completely filled, and actions are under way or done, it can be transmitted to USAID to show Regulation 216 compliance progress. ***Individual Partners must develop their own Safe Use Action Plans (SUAPs), which MUST be consistent with this PERSUAP, and which must be approved by both the Mission Environmental Officer and the respective COR/AOR.***

Actions	Start	End	Party Responsible	Budget
Ensure that EGP farmers do not use insecticide endosulfan for treating their crops				
Ensure that EGP farmers do not use aluminum phosphide on field crops or to fumigate stored or export produce (instead use trained and equipped fumigation services).				
Ensure that farmer associations each have 1 or 2 sets of PPE for the group to share; assign responsible PPE caretakers				
Ensure that farmers use PPE and apply pesticides early in the morning, or late afternoon when there is little wind and no rain				
Determine which of the registered pesticides are of the carbamate class, and which are of the organophosphate class.				
If carbamate or organophosphate-class pesticides are				

used, perform base-line testing for cholinesterase inhibition, and establish a periodic cholinesterase monitoring schedule.				
For use by beneficiary farmers of certain RUP chemicals listed in PERSUAP Annex 6, have 1 or 2 project trainers from each implementing partner that does training receive row crops and fruit tree crops RUP training and certification online or at a USA State Extension Service that focuses on tropical/subtropical crops; transfer this knowledge to farmers				
Provide training in the need for exclusion times and zones for areas that are being or have been sprayed. Include information about sensitive populations (pregnant women, children, elderly, sick).				
Annually test and certify pesticide users on knowledge of human safety and environmental protection				
Collect MSDSs for each commercial pesticide that beneficiary farmers use, keep copies on record at project field staff office sites, and farm sites; use MSDSs for training information on risks and risk reduction				
Contact MAGA every 3 months to obtain most current information on new pesticide regulatory changes as well as any new pesticide registrations; keep current lists of MAGA-registered pesticides at project sites				
Assign pesticide commercial product names to Active Ingredients in Annexes 3, 5, and 6				
Make copies of the list (Annex 5) of pesticide commercial product names that should not be used by beneficiary farmers with USAID support, and distribute to all project field extension staff				
Ensure that EGP farmers do not use pesticides containing active ingredients in Annex 5				
EGP test commercially-available natural chemicals listed in Annex 8 (some are already in use by EGP farms – promote to additional farm associations, especially organic nematode controls				
Test the crop-pest-specific PMPs (Annex 1) with EGP beneficiary farmers, during training or field visits, for field validation and, if needed, modification or adaptation				
Use PERSUAP PMP information to produce crop-specific production field reference guides or posters for farmers to anticipate and manage pests				
During training, emphasize IPM concepts, practices and methods (Sections 2.5 and 3.3) that can reduce				

pesticide use				
During training, raise awareness of and promote, the use of green-label synthetic pesticides as well as natural pesticides (Annex 8)				
Annual and refresher training programs should include the following topics: • types and classes of pesticides • human and environmental risk associated with pesticides (MSDSs, Annex 3) • half-life and breakdown products of pesticides during the selection process • use and maintenance of PPE (Annex 11) • monitoring for the development of pesticide resistance • understanding information on pesticide labels • proper collection and disposal of pesticide rinsate and packaging (Annex 15, Agrequima) • the importance of keeping children away from the field while spraying is occurring and kept out after spraying has occurred • avoiding the storage or use of pesticides in or near national parks, areas susceptible to mudslides or floods, or headwaters leading to rivers where endangered species are known to exist • mitigation measures for reducing risks to environmental resources and biodiversity (PER Sections 3.5, 3.7, & 3.8) • ensuring pesticide applicators notify beekeepers about spray activities, and to protect bees, use pesticides early in the morning or late in the afternoon and when no heavy winds or rain are present • basic first aid for pesticide poisoning (Annex 13) • Awareness of pesticides (especially some herbicides) with high ground water contamination potential where water tables are high or easy to reach (Annex 3).				
Invite farm store owners/operators to participate in pesticide safety training				
For all farms, introduce pesticide record-keeping concepts and tools (Annex 16) or following GlobalGAP or Organic standards				

Prime contract managers write PERSUAP issues and mitigation into each grant or sub-contract language and in all annual work plans, on intentions to monitor progress of farmers and farm associations in implementing Safe Use Recommendations, and any outstanding pesticide risk issues, any use of new IPM tactics, any farm certification issues and other risk mitigation measures to be taken.				
Project managers should keep records on the implementation of the recommendations found in the PERSUAP, including any evidence of pesticide resistance development, and report on them in Annual Reports, under a heading titled "Environmental Compliance and Best Practices."				
Project Managers should report on any changes in MAGA's pesticide regulations and product registrations, and consequently, any changes desired to the list of pesticides proposed for use by EGP beneficiaries. Annually amend the PERSUAP accordingly. Any changes proposed can also be included in the Project's Environmental Mitigation & Monitoring Plan (EMMP), if one is developed.				
As time permits, EGP project staff economists perform economic analyses comparing pesticides to determine the most effective choice – with low health and environmental impact potential – that is affordable for the crop grown				
Assure that applicable requirements for labeling and packaging are followed.				
Follow GlobalGAP recommendations for disposal provisions of used pesticide containers (Annex 15). Of these options, require program managers to identify local option(s) for container recycling or disposal				

Projects Management Requirements: • establish pesticide quality standards and control procedures • provide for enforcement • require good packaging and clear and adequate labeling • define and assure safe use practices • define appropriate methods of pesticide handling, storage, transport, use and disposal. • integrate Mitigation Measures, for example: • avoid disposal of treatment solution in bodies of water • avoid washing application equipment where the residues would impinge on bodies of water • for bulk pesticides, make provisions for spill prevention and clean-up				

Action Plan Goals: Decrease the number of beneficiary farmers unaware of pesticide safety, environmental and natural resource protection, and IPM concepts

Action Plan Discussion:

Action Plan Final Sign-off: COP _____, Date: _____

Once filled in and signed by COP, this Action Plan can be sent to USAID for project management monitoring purposes, so USAID staff can see the degree to which PERSUAP recommendations are being implemented, issues with implementation, and set future targets for impacts of pesticide safety activities.

ANNEX 1. MATRIX OF USAID GUATEMALA-SUPPORTED CROPS WITH MAJOR PESTS, FARMER MANAGEMENT TOOLS CURRENTLY IN USE AND RECOMMENDED ADDITIONAL TOOLS

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
1. Café, Coffee		
Broca del Café, Coffee Berry Borer *Hypothenemus hampei*	• In warmer low altitude locations, where broca is more prevalent, as well as some higher altitudes, when female beetles are flying in spring, farmers very often spray • Use home-made pheromone & alcohol traps, removed 130 days after blooming • Coffee plant pruning, aerating with some exposure to sun • Pruning of the trees used as natural shade.	• Sanitation – make sure there are no unpicked infested beans left on the trees or laying on the ground. Boil & compost infested cherry. • Use of home-made pheromone traps in spring – increase the number of farmers doing this. • Crop pruning and aerating • Pruning of the trees used as natural shade • Use of hyperparasitoids (micro-hymenoptera), if made available, affordable and practical (especially on organic farms). • Production and use of *Beauveria bassiana* fungal spores, *Beauveria bassiana* (Naturalis L).
Ojo de gallo, Cercospora *Cercospora [Mycosphaerella] coffeicola*	• Canopy management • Crop aeration and pruning • Removal and destruction or composting of infected leaves	• Sanitation – remove and burn or compost old orchard coffee bushes that are infested, not maintained and no longer productive. • Maintain well-fertilized plants with 50% shade cover. • In presence of the disease, the pruning cycles should be shortened to obtain good production. • Application of copper hydroxide (Kocide WG); cyproconazole (Alto 100 SL); azoxystrobin (Amistar 50 WG); mancozeb (Manzate 80 WP).

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
Anthracnosis *Colletotrichum gloeosporioides*	• Hand pruning of diseased leaves and twigs, but this practice is executed depending on coffee international prices.	• Sanitation – remove old orchard coffee bushes that are infested and not maintained. • Shade trees canopy must be thinned. • Maintain a healthy, pruned plant • Crop pruning and aerating • Pruning of the trees used as natural shade • More extensive farms spray Amistar (azoxystrobin) only one time per year, depending on the coffee international price trends. • Application of azoxystrobin (Amistar 50 WG); copper hydroxide (Kocide WG); cyproconazole (Alto 100 SL), azoxystrobin (Amistar 50 WG); mancozeb (Manzate 80 WP)
Phoma *Phoma species*	• Fungicides used by farmers in Guatemala include: same as used for Cercospora. • Small farmers usually spray copper hydroxide, because the other fungicides are expensive.	• Shade trees canopy must be thinned. • Maintain healthy, pruned plant. • Crop pruning and aerating • Pruning of the trees used as natural shade • Application of azoxystrobin (Amistar 50 WG); cyproconazole (Alto 100 SL); mancozeb (Manzate 80 WP); copper hydroxide (Kocide WG)
Malezas, Weeds Various species Heavy weed growth competes with coffee plants for soil nutrients	• Farmers moving toward organic production are using hand cutting of weeds	• At end of the harvest, manual removal of weeds two times a year: first weed control a month before the harvest and the second four months after the first pruning • Small farmers mostly use hand cutting because of the high cost of herbicides and low cost labor availability in the coffee zone. • Application of glyphosate (Roundup 36 SL); metsulfuron methyl (Ally 60 WG); oxyfluorfen (Goal 24 EC)
2. Fresas, Strawberries		
Moho gris (Botrytis), Gray mold *Botrytis cinerea*	• Plastic mulch covertures to avoid fruit contact with soil and minimize weeds that enhance microclimate conditions favorable to disease dispersion.	• Hand pruning of diseased flowers and fruits every week. • Tissue management and cutting that leads to renewal of producing branches. • Application of copper hydroxide (Kocide WG); sulfur (Sulfur, Thiovit, Kumulus D); azoxystrobin (Amistar 50 WG); mancozeb (Manzate 80 WP)
Root diseases *Phytophthora* spp.	• Solarization of soil before planting.	• Elimination of plant residues from field surface after every growing cycle.

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
Rhizoctonia sp.		• Crop rotation with maize or other crops. • Application of boiling hot water over the planting hole after mulch installation and previous to planting date. • Application of dimethomorph (Forum 15 EC)
Nematodes Various genera and species	• Soil solarization.	• Use of soil solar sterilization with black plastic. • Application of ProMax from Bio Huma Netics (www.humagrow.com); *Myrothecium verrucaria* (DiTera DF)
Tripido de las flores, Western flower thrips *Frankliniella occidentalis*	• Soil mulches • Weed control in and around fields • Use of protective covers for green house production • Sampling for thrips by examining early flower clusters	• Remove weed and crop residue • Use Yellow and blue traps to monitor or for mass trapping • Use of patches of trap crops. • Crop monitoring for thrips • Use of Biological control by *Orius insidiosus* if available and cost-effective • Application of Azadirachtine (Azadirachtina, Neem oil)
Arañita Roja, Twospotted spider mite *Tetranychus urticae* **Arañita, Carmine spider mite** *Tetranychus cinnabarinus*	• Plant density of 6-7 /m2 • Weed control focused on species that act like alternative hosts for mites.	• Preplant chilling (vernalization) directly promotes plant vigor. Fall transplant, nursery location, pre-harvest chilling, nursery harvest date, and length of pretransplant supplemental cold storage can all affect a plant's vernalization. • Cultural and biological controls, including releases of predatory mites, and sprays of rosemary oil or organic stylet oil are acceptable for use on organically certified strawberries • Avoid unnecessary spraying and treat only infested portions of the plantation • Application of spiromesifen (Oberon 24 SC); dicofol (Mitigan 18 EC); avermectin (Vertimec 1.8 EC)
3. Moras, Blackberries		
Trips, Thrips Various species	• Use of sticky bright yellow or blue traps for monitoring and mass trapping.	• Remove weed and crop residues. • On use of yellow and blue traps, these traps must be changed every week to keep fresh sticky substance. • Soil mulches preferring silver-grey or brilliant colors. • Application of imidacloprid (Confidor 35 SC, Plural 20 SI); thiamethoxam (Actara 25 WG); spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)
Mildew,	• Plastic mulch covering to avoid plant contact with soil and minimize weeds that	• Design of good drainage system to avoid soil flooding.

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
Downey Mildew *Peronospora sparsa*	enhance microclimate conditions favorable to disease dispersion.	• Use sanitation: Weed and crop residues removal to avoid re-infection of new plant tissues and neighboring plants. • Rotate among mancozeb (Manzate 80 WP); dimethomorph (Forum 15 EC)
Moho gris (Botrytis), Gray mold *Botrytis cinerea*	• Weekly cleaning pruning and removal of old and diseased flowers or fruits.	• Rotate among copper hydroxide (Kocide WG); sulfur (Sulfur, Thiovit, Kumulus D); mancozeb (Manzate 80 WP); azoxystrobin (Amistar 50 WG)
Gusanos, Green looper worms Scientific names not available	• Most farmers use hand control of the green worms when they prune or clean old tissues and rotten fruits.	• Application of azadirachtina (neem oil); *Bacillus thuringiensis*
4. Lechugas (Romano, amarillo, morada, Salinas), Lettuces (Romaine, green and red leaf, Iceberg)		
Trips, Thrips Various species	• Use of sticky yellow or blue traps.	• Weed and crop residues removing after harvest. • Increase the density of sticky traps for monitoring and mass trap of adult insects. • Application of sulfur (Sulfur, Thiovit, Kumulus D); garlic oil (extracto de ajo, several products)
Afidos, Aphids Various species	• Use of sticky yellow or blue traps.	• Use and increase the density of sticky yellow and blue traps. • Weed management to avoid alternative hosts for aphids. • Avoid the broad spectrum insecticides to minimize natural enemies' destruction. • Application of Agricultural narrow range oil/dormant oil (several products); garlic oil (extracto de ajo, several products)
Gusano cogollero, Armyworm *Spodoptera exigua*	• Use of early warning monitoring	• Use of neem oil and BT, minimize the broad spectrum insecticides spraying to enhance the development of natural enemies that include *Trichogramma* species, Braconid wasps and other micro hymenoptera wasps. • Application of azadirachtina (neem oil); methoxyfenozide (Intrepid 24 SC); tebufenozide (Mimic 24 SC); *Beaveria bassiana; Bacillus thuringiensis*
Mosca blanca, Whitefly	• Use of bright yellow or blue sticky traps for monitoring and control of adult stages.	• Integrated crop management includes the host freed periods to conserve natural enemies. • Plant away from other whitefly host crops like cucurbits or

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
Bemisia tabaci		tomato. • Use a monitoring program to make the decision for spraying of pesticides. • Use of AgriBon covers will be a choice if it is necessary at least 15 days after planting. • Application of imidacloprid (Confidor 35 SC, Plural 20 SI); thiamethoxam (Actara 25 WG); spinosad (Spinoace, Tracer, Spintor)
Minador de la hoja, Leaf miners *Lyriomyza species*	• Use of silver plastic mulch with a reflectent color. • Use of sticky yellow or blue traps.	• Removal of weeds and crop residues after harvest and the compost of this. • Increase the density of sticky traps, checking every week to keep the sticky effect and monitoring insect populations and mass control for adult stages. • Application of avermectin (Vertimec 1.8 EC); cyromazine (Trigard 75 WP); azadirachtin (azadirachtina (neem oil); spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)
Mildew velloso Downy Mildew *Bremia lactuca*	• Plastic mulch covering to avoid plant contact with soil and minimize weeds that enhance microclimate conditions favorable to disease dispersion.	• Design of good drainage system to avoid soil flooding. • Weed and crop residues removal to avoid re-infection over new tissues and neighbor plants. • Sanitation-remove dead plants to minimize inoculum and reinfection of area. • Application of mancozeb (Manzate 80 WP); dimethomorph (Forum 15 EC)
5. Cruciferae, Crucifers, Cole crops: Brocoli, Broccoli; Repollo, Cabbage; Coliflor, Cauliflower		
Plutella Diamond-back moth *Plutella xylostella*	• For monitoring, use light traps over soap dish to control adult stages and monitoring insect population's dynamics. • Sticky bright yellow or blue traps will help to trap and control adult stages.	• Application of azadirachtina (neem oil); *Beauveria bassiana* (Naturalis L); Bacillus thuringiensis
Mariposa blanca Imported Cabbage Worm *Artogeia rapae*	• The basic control used by the farmers for this pest will be the same that are used to control *Plutella xyllostella*, above.	• Application of azadirachtina (neem oil); *Beauveria bassiana* (Naturalis L); Bacillus thuringiensis
Hernia de la col Cole crops root club	• This is a very destructive disease of col crops. Infected fields will be destroyed to 100% when the plant infection starts at early stages. • Resistant spores of this microorganism will remain viable for about 10 years.	• Crop rotation. • Use of certified healthy plants to avoid diseases spreading.

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
Plasmodiophora brassicae	• There are no chemical controls for this disease. • Soils with low pH will favor the infection and accelerate crop destruction.	• Infected plants must be extracted and burned out of agricultural fields. • Dolomitic calcium or gypsum must be used at least once per year to raise pH. • No fungicides work
6. Cebollas dulces blancas y amarillos, White and yellow onions		
Trips, **Thrips** **Various species**	• Use of sticky yellow or blue traps	• Sanitation-remove weed and crop residues after harvest. • Increase the density of sticky traps for monitoring and mass trap of adult insects. • Application of sulfur (Sulfur, Thiovit, Kumulus D); garlic oil (extracto de ajo, several products)
Gusano cortador, **Cutworm** *Agrotis subterranea*	• Good soil preparation • Weed control	• Application of azadirachtina (neem oil); *Beauveria bassiana* (Naturalis L); Bacillus thuringiensis
Gusano cogollero, **Armyworm** *Spodoptera exigua*	• Good soil preparation • Weed control	• Application of *Beauveria bassiana* (Naturalis L); Bacillus thuringiensis
Botrytis wilt *Botrytis alli*	• Sprayed fungicides includes: mancozeb (Dithane 80 WP), folpet (Folpan 48 SC).	• Sanitation—remove diseased onions, clean and disinfect all harvest equipment • Good drainage and crop rotation after 2 years • Application of mancozeb (Manzate 80 WP); chlorothalonil (chlorothalonil, Balear 50 SC)
Fusarium *Fusarium* sp.	• Farmers use resistant varieties •	• Soil disinfection with organic mulch and soil amendments that increase humic acid content • Application of *Trichoderma harzianum (several products)*; mancozeb (Manzate 80 WP); chlorothalonil (chlorothalonil, Balear 50 SC)
Mildiu Algodonoso/ **Mildiu Lanoso,** **Downy Mildew** *Peronospora destructor*	• Crop rotation • Use certified seed and good drainage • Plastic mulch covering to avoid plant contact with soil and minimize weeds that enhance microclimate conditions favorable to disease dispersion.	• Heat treatment of bulbs at 35, 40 °C for 4 to 8h reduce the disease significantly. • Bulb dipping with fungicides • Eliminate residue, plant during dry season, avoid irrigation during heat of the day

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
		• Application of mancozeb (Manzate 80 WP); copper hydroxide (Kocide WG); chlorothalonil (chlorothalonil, Balear 50 SC); dimethomorph (Forum 15 EC, Acrobat 50 WP)
Raiz Rosada, Pink Root *Pyrenochaeta terrestris*	• Crop rotation	• Soil solarization
Pythium *Pythium spp.*	• Water regulation must be a good agricultural practice, then use drip irrigation.	• Dipping the seedlings with fungicides • Application of chlorothalonil (chlorothalonil, Balear 50 SC)
Sclerotium Southern blight *Sclerotium rolfsii*	• Promotion of antagonist fungi in the soil by use of compost	• Application of mancozeb (Manzate 80 WP)
Alternaria *Alternaria porri*	• Sanitation, clean up crop residues, burn.	• Seedling dipping with fungicides • Application of chlorothalonil (chlorothalonil, Balear 50 SC, as seedling dip); mancozeb (Manzate 80 WP); azoxystrobin (Amistar 50 WG). • Chlorothalonil is the most effective in the inhibition of spore germination, followed by mancozeb, but strobilurin and triazole fungicides must be included in a preventive rotational fungicide spray program.
Malezas Weeds	• Use soil mulches and pruning. • Hand/hoe weeding	• Continue hoe and hand weeding. • Use drip irrigation to regulate water in the crop and avoid weed emergence. • Application of oxyfluorfen (Goal 24 EC)
Minador de la hoja, Leaf miners *Lyriomyza species*	• Use of plastic mulch with a reflectent color. • Use of sticky yellow or blue traps.	• Use of plastic mulch, silver grey will be the better option, because of his repellent effect. • Removal and compost of weeds and crop residues after harvest and the. • Increase the density of sticky traps, checking every week to keep the sticker effect and monitoring insect populations and mass control for adult stages. • Application of spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC); cyromazine (Trigard 75 WP)

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
7. Apio, Celery		
Mosca blanca, White flies *Bemisia tabaci*	• Crop rotation • Use pesticides only when it necessary. • Destroy weeds and host crops. • Crop monitoring.	• Encourage farmers to use a soil drench with fungus *Trichoderma harzianum* • Crop monitoring is important; the farmer inspects the entire area in the field to locate the presence of pests. • Whiteflies can also be monitored using bright yellow sticky traps. • Learn to anticipate and prevent problems; reduce plant stress. Use virus-free and whitefly-free transplants. • Use crop rotation. • During non-planting periods conserve natural enemies. • Application of *Trichoderma harzianum (several products)*; Actara (Thiamethoxam); pymetrozine (Pymetrozine 50 WG)
Trips, Flower thrips *Frankliniella occidentalis*	• Use blue sticky traps • Crop monitoring • Transplanting health plants. • Use pesticides only when it necessary. • Destroy weeds and host crops. • Clean and disinfecting the greenhouse from plants the debris from previous crops. • Humidity (RH), temperature control	• Planting sites should be well drained and free of low-lying areas. • Adult thrips can also be monitored using bright blue sticky traps. • The drainage area of the field should be kept free of weeds and volunteer crop plants, particularly those in the same group. • Application of thiamethoxam (Actara 25 WG); spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC); *Beauveria bassiana* (Naturalis L); avermectin (Vertimec 1.8 EC); Azadirachtina (neem oil) extract; Acetamiprid (Rescate 20 SP); imidacloprid (Confidor 35 SC, Plural 20 SI)
Acaro rojo, Red spider mites *(Tetranychus spp.)*	• Crop monitoring	• Plant away the other mite host plants. • Destroy weeds and host crops as soon as possible, including the head rows. • Always monitor before treatment with miticides. • Application of avermectin (Vertimec 1.8 EC) • Use an insecticidal soap or oil for management. Oils and soaps must contact mites to kill them so excellent coverage, especially on the undersides of leaves, repeat applications may be required.
8. Cucurbits: Zucchini, calabaza, calabacitas, squashes, pumpkin		
Mosca blanca, White fly	• Use of sticky bright yellow or blue traps for monitoring and adult stages control.	• Remove and burn crop residues and weeds. • Weed removal, specially Solanaceae and Malvaceae family

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
Bemisia tabaci		species that will be alternative hosts of this insect. • Use of AgriBon cover at early stage of seedlings, about 20 days. • Increase the density of sticky traps, changing and reviewing weekly to keep the sticker potential. • Host free periods conserve natural enemies. • Use of garlic oil based repellents. • Spray mineral oil to control nymphs. • Plant away other whitefly host crops like tomato, pepper bell and other cucurbits. • Use a rotational pesticide program. • Application of garlic oil (extracto de ajo, several products); Agricultural narrow range oil/dormant oil (several products); imidacloprid (Confidor 35 SC, Plural 20 SI); thiamethoxam (Actara 25 WG); pymetrozine (Pymetrozine 50 WG); *Trichoderma harzianum (several products)*; spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)
Minador de la hoya, Leaf miners *Lyriomyza species*	• Use of plastic mulch with a reflectent color. • Use of sticky yellow or blue traps.	• Weed and crop residues removal and burning after harvest. • Use of plastic silver gray mulch with repellent properties. • Spray garlic oil based repellents and mineral oil. • Use a rotational pesticide spraying program. • Application of garlic oil (extracto de ajo, several products); Agricultural narrow range oil/dormant oil (several products); imidacloprid (Confidor 35 SC, Plural 20 SI); thiamethoxam (Actara 25 WG); spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)
9. Arveja china, Arveja dulce, Snow peas, Sugar snaps		
Minador de la hoja, Leaf miners *Lyriomyza species*	• Weed and crop residues removal after harvest. • Crop rotation with corn, onions or other species not related with snow peas.	• Use of plastic mulch with a reflectent color, silver grey will be one of the more effectives. • Use of yellow or blue sticky traps. • Application of imidacloprid (Confidor 35 SC, Plural 20 SI); acetamiprid (Rescate 20 SP); spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC); cyromazine (Trigard 75 WP)
Mancha de la vaina Black spot of pod *Ascochita* sp.	• Strings must be hung on time to hold up the new foliage so that it does not hang over the pods and flowers, creating excessive humidity favorable to spreading this disease.	• Regulation of Nitrogen fertilizers at pod production time (the increase of this element will produce more foliage which is favorable for the disease development). • Application of copper hydroxide (Kocide WG); copper sulfate (several products); sulfur (Sulfur, Thiovit, Kumulus D);

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
		mancozeb (Manzate 80 WP); azoxystrobin (Amistar 50 WG); tryfloxystrobin (Flint); chlorotalonil (Daconil)
Trips, Thrips *Frankiniella* sp.	• Use of plastic mulch with a reflectent color. • Use of sticky yellow or blue traps for monitoring and mass trapping.	• Weed and crop residues removing after harvest and compost or burn it. • Application of garlic oil (extracto de ajo, several products); Agricultural narrow range oil/dormant oil (several products); imidacloprid (Confidor 35 SC, Plural 20 SI); thiamethoxam (Actara 25 WG); spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)
10. Ejote Frances, green beans, Habas, faba beans		
Trips, Thrips *Thrips tabaci*	• Soil mulches • Field sanitation • Crop rotation • Apply agricultural oil between each application of other chemicals.	• Keep production areas free of weeds, which can serve as hosts for thrips populations. • Monitor and trap flower thrips using blue sticky cards. • Most insecticides must be applied at least two times, 5 to 7 days apart, for efficacy against thrips. • Application of *Beauveria bassiana* (Naturalis L); avermectin (Vertimec 1.8 EC); Azadirachtina (neem oil) extract; Acetamiprid (Rescate 20 SP); imidacloprid (Confidor 35 SC, Plural 20 SI); spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)
Pulgones, Aphids *Aphis* spp. *Myzus* spp.	• Crop rotation • Some farmers use insecticidal soap. • Use of yellow or blue sticky traps. • Weed control in and around the crop field.	• Crop rotation. • Use of predators such as green lacewing larvae, lady beetles, and syrphid fly larvae prey on this aphid as well as on other aphid species. • Sanitation. Discard all crop residues (compost or plow/disc under) as soon as harvest is complete. Keeping fields, ditch banks, and fence lines weed free may also help in reducing virus inoculum. • Look for aphids on the underside of outer leaves and on both sides of tender central leaves. After cupping, heads should be opened if necessary to look for aphid colonization. • If control is needed, treat when aphids are found to be reproducing, particularly when second and later generation of wingless females has started reproduction. Aphid populations are easier to control before the plants begin to cup.

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
		• Application of soap sprays (potassium salts of fatty acids, several products); imidacloprid (Confidor 35 SC, Plural 20 SI); spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC); acetamiprid (Rescate 20 SP); pymetrozine (Pymetrozine 50 WG)
Bacteriosis Bacterial soft rot *Erwinia sp.*	• Good nutritional program to promote resistance once the disease appears on the field • Planting on raise bed. • Copper based bactericides and harvesting early with minimum 90 days old	• Planting on raised beds in poorly drained areas may also reduce bacterial infections. • Careful harvest handling, grading and sanitation (clean harvest tools) are the only ways to reduce the problem. • Application of copper hydroxide (Kocide WG)
Alternaria, Black rot *Alternaria spp.*	• The disease can be kept under check if a well-drained soil is selected and suitable crop rotation is adopted. • After 60 days from planting apply weekly a systemic every 14 days	• Since the fungus can survive in the seed, hot water treatment of seed at 50°C for 15 minutes is recommended. • Seed treatment with fungicides. • Crop rotation and destruction of infected plant material in the field will minimize the disease infection. • Application of iprodione (Rovral); azoxystrobin (Amistar 50 WG); mancozeb (Manzate 80 WP); chlorothalonil (chlorothalonil, Balear 50 SC); thiram (Thiram 50 WP, as seed treatment)
Nematodos, Nematodes *Various genera*	• Soil sampling and testing previous planting. • Crop rotation with potatoes, lettuce, garlic or other crops on the area.	• To make management decisions, it is important to know which nematodes are present and to estimate their population. If a previous crop had problems caused by nematodes that are also listed as pests of Cole crops, population levels may be high enough to cause damage to subsequent crops. • The use of pest-free transplants is the most important cultural control for nematodes on cabbage. Transplants should be produced in sterile growing medium or in soil that has been fumigated. • If nematode species have not previously been identified, take soil samples and send them to a diagnostic laboratory for identification. • Use of calcic cianamide to disinfect soil 25 days before seeding. • Application of a new biological nematocide called ProMax from Bio Huma Netics (www.humagrow.com) to control nematodes and some fungal diseases; *Myrothecium verrucaria* (DiTera DF).
Aphidos caupí, Cowpea aphid	• Use regular monitoring with yellow sticky traps	• Many predators and parasites attack aphids, especially in fields

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
Aphis craccivora	• Use resistant varieties • Use sanitation	that are not sprayed or sprayed with less toxic materials. • Remove infested culls and weedy species around fields that may harbor the aphid between crops. • **Organically Acceptable Methods:** Biological and cultural controls as well as sprays of insecticidal soap, which can give partial control of aphids, are organically acceptable methods. Insecticidal soap sprays, however, may be phytotoxic under some conditions and rates, so test them before widespread applications take place. • Application of Agricultural narrow range oil/dormant oil (several products); acetamiprid (Rescate 20 SP); pymetrozine (Pymetrozine 50 WG); malathion (Malathion 50 EC); thiamethoxam (Actara 25 WG); imidacloprid (Confidor 35 SC, Plural 20 SI); soap sprays (potassium salts of fatty acids, several products)
Mosca blanca, White fly *Bemisia tabaci*	• Crop rotation • Destroy weeds and host crops. • Crop monitoring.	• In addition to causing direct damage to the plant, whitefly is a vector of viruses. • Whitefly can be monitored using bright yellow sticky traps. • Integrated crop management. • Plant away from other whitefly host plants like cucurbits. • Use pesticides only when it necessary after a monitoring program. • Application of thiamethoxam (Actara 25 WG); pymetrozine (Pymetrozine 50 WG); *Trichoderma harzianum (several products)*; imidacloprid (Confidor 35 SC, Plural 20 SI); Actara (Thiametoxam)
Marchitez/mal del talluelo, Damping off diseases: Pythium root rot, *Pythium spp* Phytophthora root rot, *Phytophthora spp*	• Use regular monitoring, • Use resistant varieties • Use sanitation	• Provide adequate field drainage and prevent excessive seepage from irrigation canals. Most importantly avoid over-irrigating, especially during periods of high temperatures. • In soils where drainage is a problem, plant in raised beds, use sprinkler irrigation • Rotate to non-susceptible crops to reduce inoculum potential. Carefully adjust cultivating and thinning equipment to reduce mechanical injury to feeder roots. • Application of thiram (Thiram 50 WP); mancozeb (Manzate 80 WP); copper hydroxide (Kocide WG)

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
Fusariosis Fusarium rot *Fusarium spp*	• Use monitoring • Use resistant varieties	• To minimize the potential for seedling diseases, use methods that favor rapid seedling emergence, including planting seeds as shallowly as practical and managing soil moisture (pre-plant irrigate, seed into moist soil and delay second irrigation until seedlings are beyond susceptible stages). • Buy seeds treated with protective fungicides that are effective against the pathogens in the soil to be planted. • Application of mancozeb (Manzate 80 WP); iprodione (Rovral); tryfloxystrobin (Flint 50 WG)
Gusanos cortadores, Cutworms *Agrotis sp.*	• Use regular monitoring • Use sanitation	• Cutworms have numerous natural enemies, but none can be relied on to bring a damaging population down below economic levels. • Check for cutworms in weeds around the edges of the field before planting. Remove weeds from field margins and plow fields at least 10 days before planting to destroy larvae, food sources, and egg-laying sites. • After the crop is up, check for a row of four or more wilted plants with completely or partially severed stems. If you find damaged plants, look for cutworms by digging around the base of plants and sifting the soil for caterpillars. • If substantial numbers of cutworms are found, baits can be used for control • Application of imidacloprid (Confidor 35 SC, Plural 20 SI); indoxacarb, S isomer (Avaunt 30 WG); Bacillus thuringiensis (BT) kurstaki & aizawai; spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)
Mancha foliar, Leaf spot *Cercospora spp*	• Use monitoring • Use resistant varieties	• Provide adequate field drainage and prevent excessive seepage from irrigation canals. Most importantly avoid over-irrigating, especially during periods of high temperatures. • In soils where drainage is a problem, plant in raised beds, use sprinkler irrigation, and rotate to non-susceptible crops to reduce inoculum potential. • Carefully adjust cultivating and thinning equipment to reduce mechanical injury to feeder roots. • Application of mancozeb (Manzate 80 WP); copper hydroxide

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
		(Kocide WG); iprodione (Rovral); tryfloxystrobin (Flint 50 WG)
Gallina ciega, White grub *Phyllophaga* spp. **Gusano alambre, Wireworm** *Agriotes spp.*	• Use of granular insecticides incorporated to soil at the time of planting. • Use of light traps with soap dish to control adult stages in April to June. • Good soil tillage	• Till soil a week before planting, to expose larvae to predatory birds. • Use light traps when large densities of the adult stage appear. • Use compost and manure.
11. Zanahorias, Carrots		
Tizón de la zanahoria, Carrot leaf wilt *Alternaria dauci*	• Crop residue and weed removal after harvest will reduce inoculum for next crop cycle.	• Use adequate planting densities to avoid excessive moisture in crop foliage. • Use resistant varieties. • Application of mancozeb (Manzate 80 WP); copper hydroxide (Kocide WG); chlorothalonil (chlorothalonil, Balear 50 SC); azoxystrobin (Amistar 50 WG)
Nematodos, Nematodes *Various genera*	• Soil sampling before to make decisions about if the field is adequate to grow carrots.	• Soil solarization. • Application of a new biological nematocide called ProMax from Bio Huma Netics (www.humagrow.com) to control nematodes; *Myrothecium verrucaria* (DiTera DF)
12. Papaya		
Papaya fruit fly, Mosca de la papaya *Toxotrypana curvicauda*	• A monitoring program is established in Guatemala for papaya growers and exporters. PIPAA and USDA give support with this monitoring and pre-inspection program. • Weed control in and around the crop field. • Ripe fruit is collected from field in plastic bags and managed to avoid an infestation.	• It is too late to attempt control measures after the female fruit fly has deposited eggs in the fruit. Consequently, control procedures should be directed at preventing egg-laying either by mechanical means or by applying insecticides to kill the adult female before she deposits her eggs. • Control of the fly may be achieved by mechanical protection such as the use of paper bags. Each fruit may be enclosed in a 3-5 pound size bag tied around the fruit stem to hold the bag. Newspaper, one-half sheet (about 12-15 inches in size), may be rolled to enclose the fruit, then tied around the fruit stem, and also the free end. Bagging should begin when the fruit is small, shortly after the flower parts have fallen. This method of control is more adapted to small (1 to 25 plants) than to large (one-fourth acre or more) plantings. Although bagging the fruit

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
		is the most certain method of control, it is a laborious process and requires attention at regular intervals (10 to 14 days) to keep the young fruit covered. Also, this procedure will injure some of the fruit unless handled carefully. • Sanitation is important in the control of the papaya fruit fly. Destroy all dropped and prematurely ripe fruit, as well as small fruit suspected of being infested to prevent the larvae from developing into adult fruit flies. • Application of pesticides need to be timed precisely; few are available for control.
Afidos/chicharrita, Aphids/Leafhopper Cowpea aphid, *Aphis craccivora* Cotton aphid, *Aphis gossypii* Green peach aphid, *Myzus persicae* Papaya leafhopper *Empoasca papaya*	• Use regular monitoring, yellow sticky traps • Use resistant varieties • Use sanitation	• When populations are heavy, aphids can stunt seedlings; however, economic damage rarely occurs on older plants. • Many predators and parasites attack aphids, especially in fields that are not sprayed or sprayed with less toxic materials. • Remove infested culls and weedy species around fields that may harbor the aphid between crops. • Application of Agricultural narrow range oil/dormant oil (several products); acetamiprid (Rescate 20 SP); pymetrozine (Pymetrozine 50 WG); malathion (Malathion 50 EC); thiamethoxam (Actara 25 WG); imidacloprid (Confidor 35 SC, Plural 20 SI)
Cochinilla de papaya, Papaya mealybug *Paracoccus marginatus*	• Use regular monitoring, yellow sticky traps • Use sanitation	• Can use orchard design, trap cropping and border trapping using sections of 'sacrifice' papaya trees with pheromone traps for control. • Sanitation by collection and destruction of infested fruits prior to adult emergence from fruits. • Protein bait sprays with spinosad may become available. • Application of Beauveria bassiana (Naturalis L); soap sprays (potassium salts of fatty acids, several products); spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC, and in protein baits)
13. Citricos: Limon persa, Limon criollo, Naranja dulce, Lemons and Oranges		
Acaros, Spider mites	• Use regular monitoring • Use sanitation	• Spider mites have many natural enemies that often limit populations. Broad-spectrum insecticide treatments for other

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
Tetranychus spp.		pests frequently cause mite outbreaks, so avoid these when possible. • Adequate irrigation is important because water-stressed plants are most likely to be damaged. • Predator mites commercially available for purchase and release are the western predatory mite and *Phytoseiulus.* • Control dust: Apply water to pathways and other dusty areas at regular intervals. Water-stressed trees and plants are less tolerant of spider mite damage. Be sure to provide adequate irrigation. Mid-season washing of trees and vines with water to remove dust may help prevent serious late-season mite infestations. • Application of soap sprays (potassium salts of fatty acids, several products); Agricultural narrow range oil/dormant oil (several products); avermectin (Vertimec 1.8 EC)
Tripido Banda roja Red banded thrips *Selenothrips rubrocinctus*	• Use of natural enemies such as minute pirate bugs, lacewing or predatory thrips.	• Disinfection before blooming with calathion • Application of Agricultural narrow range oil/dormant oil (several products products)plus any of the following: sabadilla (Veratran D); spinetoram (Delegate); spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC); avermectin (Vertimec 1.8 EC) (Vertimec)
14. Mango		
Mosca del Mediterraneo, Mediterranean fruit fly *Ceratitis capitata*	• USDA-APHIS and MAGA-PIPAA, are developing a monitoring and fruit pre-inspection program for mango exporters in order to avoid the fruit fly dispersion to northern countries.	• Monitoring program • Canopy management • Biological control by parasitic wasps • Application of Agricultural narrow range oil/dormant oil (several products); malathion (Malathion 50 EC)
Hormigas, Ants *Solenopsis spp.*	• Ants are not controlled for in most orchards	• Boric acid • Sanitation, clean out nests • Pesticides not usually applied for ants
Cenicilla del mango Powdery Mildew *Oidium mangiferai*	• Daily monitoring, if 2 infected flowers per plant, apply sulfur and follow the recommendations for antracnosis (below)	• Application of sulfur (Sulfur, Thiovit, Kumulus D); cyproconazole (Alto 100 SL); fenbuconazole (Indar 50 OF)

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
Antracnosis, Anthracnoses *Colletotrichum gloeosporoides*	• Preventive treatment with sprays of triazole fungicides combined in a rotation program with copper formulations. • Management with cyproconazole (Alto 100) • Removal of crop residue and fallen leaf or fruit	• Removal of fallen and leftover mangoes and fallen leaves • Pruning to promote ventilation • Application of mancozeb (Manzate 80 WP); copper hydroxide (Kocide WG); cyproconazole (Alto 100 SL)
15. Rambután, Litchi		
Hiedevivo Green stink bug (GSB) *Nezara viridula*	• Use resistant varieties	• Many parasitoids control GSB eggs and larvae, so do not use broad-spectrum insecticides; monitor for parasitism levels and make treatment decision accordingly • Destroy weeds (legumes, thistles, mustards, and mallows) that are good overwintering hosts for adult stink bugs around fields • A pheromone lure developed in Australia may work on GSB • Application of thiamethoxam (Actara 25 WG); imidacloprid (Confidor 35 SC, Plural 20 SI); kaolin clay (several products); soap sprays (potassium salts of fatty acids, several products)
Trips, Flower thrips *Frankiniela occidentalis*	• Use resistant varieties. • Correctly identify the problem; if insect or disease, learn the life cycle and habits. • Learn to anticipate and prevent problems; reduce plant stress.	• Do crop rotation. • Adult thrips can also be monitored using bright blue sticky traps. • Application of thiamethoxam (Actara 25 WG); *Trichoderma harzianum (several products)*; *Beauveria bassiana* (Naturalis L); avermectin (Vertimec 1.8 EC); Azadirachtina (neem oil) extract; Acetamiprid (Rescate 20 SP); imidacloprid (Confidor 35 SC, Plural 20 SI); spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)
Afidos, Aphids *Myzus persicae*	• Use of yellow or blue sticky traps.	• Crop rotation, plant away from other hosts. • Integrated crop management. • Crop monitoring before spraying. • Host free periods conserve natural enemies. • Use pesticides only when it necessary after a monitoring program. • Destroy weeds and host crops as soon as possible, including the head rows. • Application of garlic oil (extracto de ajo, several products); Agricultural narrow range oil/dormant oil (several products); imidacloprid (Confidor 35 SC, Plural 20 SI); acetamiprid (Rescate 20 SP);

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
		• pymetrozine (Pymetrozine 50 WG)
Pudricion radicular y de tallo por phytophthora, Phytophthora Blight *Phytophthora cryptogea*	• Use resistant varieties for grafting support. • Keep field well-drained.	• Use of resistant varieties. • Use raised-bed. • Crop monitoring is important; the farmer inspects the entire area in the field to locate the presence of blight. • Planting sites should be well drained and free of low-lying areas. • The drainage area of the field should be kept free of weeds and volunteer crop plants. • Cleaning and disinfecting machinery and tools. Flats, plug trays, benches, seeding equipment, and plant house structures should be disinfected using a sodium hypochlorite solution or other disinfectant. • Application of iprodione (Rovral); azoxystrobin (Amistar 50 WG); chlorothalonil (chlorothalonil, Balear 50 SC); copper hydroxide (Kocide WG); methyl thiophanate (Cycosin 50 SC); tryfloxystrobin (Flint 50 WG)
16. Esparragos, Asparagus		
Pudrición de corona Asparagus crown rot *Pythium sp.* *Phytophthora sp.*	• Plant in well drained soils, avoid flooding. • Water regulation must be an aid to avoid disease.	• Crop rotation with corn. • Use of fungicides must be rotational. • Application of chlorothalonil (chlorothalonil, Balear 50 SC); methyl thiophanate (Cycosin 50 SC)
17. Okras China & Tailandesa, Okras, Chinese & Thai		
Mosca blanca, Wihite fly *Bemisia tabaci*	• Use of sticky blue or yellow traps.	• Weed control in and around the field crop. • Crop rotation with corn or sorghum. • Crop residues must be eliminated from field. • Use of barriers made with corn or sorghum. • Agribon plant tunnels or covers must be applied to avoid the insect in first 20 days. • Increase the sticky traps density. • Application of Agricultural narrow range oil/dormant oil (several products); soap sprays (potassium salts of fatty acids, several products); imidacloprid (Confidor 35 SC, Plural 20 SI); acetamiprid (Rescate 20 SP); Rescate 20 SP); pyriproxyfen (Knack)

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
18. Berenjenas: China, Indu, Tailandesa, Eggplants: Chinese, Indian, Thai		
Mosca blanca, White fly *Bemisia tabaci*	• Use of sticky blue or yellow traps.	• Weed control in and around the field crop. • Crop rotation with corn or sorghum. • Crop residues must be eliminated from field. • Use of barriers made with corn or sorghum. • Agribon plant tunnels or covers must be applied to avoid the insect in first 20 days. • Increase the sticky traps density. • Application of Agricultural narrow range oil/dormant oil (several products); soap sprays (potassium salts of fatty acids, several products); imidacloprid (Confidor 35 SC, Plural 20 SI); acetamiprid (Rescate 20 SP) (Rescate 20 SP); pyriproxyfen (Knack)
Alternariosis, Alternaria black spot *Alternaria solani*	• Use resistant varieties. • Use crop rotation with other non solanaceous crops.	• Weed and crop residues must be done before planting. • Application of mancozeb (Manzate 80 WP)
19. Solanaceous Crops Tomate/Tomato, Papa/Potato		
Only on Tomato: Gusano del Cuerno del Tomate, Tomato Hornworm *Manduca spp.* & **Fruitworm del Tomate, Tomato Fruitworm** *Heliothis (Helicoverpa) zea*	• Monitor crop regularly for evidence of horn worm • In smaller plots, hand-pick horn worm caterpillars	• Application of *Bacillus thuringiensis* (BT); imidacloprid (Confidor 35 SC, Plural 20 SI); thiamethoxam (Actara 25 WG)
Mosca blanca, whitefly (virus vector) *Bemesia tabaci*	• Farmers use yellow and green sticky traps to monitor and reduce populations • Use resistant varieties	• Use Agribon macro and microtunnels • Follow proper planting time; do not plant late • To avoid resistance, rotate pesticides. • Application of *Beauveria bassiana* (Naturalis L); thiamethoxam (Actara 25 WG); imidacloprid (Confidor 35 SC, Plural 20 SI)

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
Minador de la hoja, Leaf miners *Lyriomyza spp.*	• Farmers use yellow and green sticky traps to monitor and reduce populations	• Use Agribon macro and microtunnels • To avoid resistance, rotate pesticides • Application of thiamethoxam (Actara 25 WG); imidacloprid (Confidor 35 SC, Plural 20 SI); spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC) ; cyromazine (Trigard 75 WP)
Tizón Tardio, Late Blight *Phytophthora infestans*	• Use tolerant varieties and raised-bed production • Farmers use sticks and lines (tutorado) to raise plants and fruit into the air to aerate the plant and raise the leaves and fruit away from the soil	• Drain the growing field adequately before planting • Follow proper planting date; do not plant late • Application of dimethomorph (Forum 15 EC, Acrobat 50 WP); mancozeb (Manzate 80 WP); chlorothalonil (chlorothalonil, Balear 50 SC)
Tizón Temprano, Early Blight *Alternaria solani*	• Use of tolerant varieties • Use of raised-bed planting system • Farmers use sticks and lines (tutorado) to raise plants and fruit into the air to aerate the plant and raise the leaves and fruit away from the soil	• Application of copper sulfate (several products); chlorothalonil (chlorothalonil, Balear 50 SC); azoxystrobin (Amistar 50 WG); tryfloxystrobin (Flint 50 WG)
Tizón Bacterial, Bacteriosis, Bacterial blights *Xanthomonas spp.* *Pseudomonas spp.*	• Use raised-bed production and monitor soil moisture • Farmers use bactericides containing copper hydroxide	• Sufficiently drain the growing field • Monitor the field frequently and remove dead and dying plants that are full of inoculum • Application of copper hydroxide (Kocide WG); mancozeb (Manzate 80 WP)
Tizón por Fusarium, Fusarium blight *Fusarium oxysporum*	• Use tolerant varieties and raised-bed production • Sufficiently drain the growing field and monitor soil moisture • Farmers use sticks and lines (tutorado) to raise plants and fruit into the air to airate the plant and raise the leaves and fruit away from the soil	• Application of dimethomorph (Forum 15 EC, Acrobat 50 WP); copper sulfate (several products); mancozeb (Manzate 80 WP); chlorothalonil (chlorothalonil, Balear 50 SC)
20. Melocoton, Peaches		
Roña del melocotón Apple scab/black spot *Venturia inaequalis*	• Use resistant varieties. • Use adequate plant densities.	• Make the tissue management (pruning) at the correct time. • Use a rotational spraying program with fungicides. • Application of copper hydroxide (Kocide WG); chlorothalonil (chlorothalonil, Balear 50 SC); azoxystrobin (Amistar 50 WG)
Moho gris, Gray mold	• A weekly pruning for removal of old and rotten flowers or fruits must be done.	• Application of copper hydroxide (Kocide WG); sulfur (Sulfur, Thiovit, Kumulus D); mancozeb (Manzate 80 WP); azoxystrobin

Pests	Management Tools Guatemala Farmers Use (IPM/MIP)	Additional Recommended Management Tools (IPM/MIP + additional pesticides)
Botrytis cinerea		(Amistar 50 WG)
Trips, **Flower thrips** *Frankiniela occidentalis*	• Learn to anticipate and prevent problems; reduce plant stress. • Adult thrips can also be monitored using bright blue sticky traps	• Application of thiamethoxam (Actara 25 WG); Trichoderma harzianum (several products); Beauveria bassiana (Naturalis L); avermectin (Vertimec 1.8 EC); • Azadirachtina (neem oil) extract; Acetamiprid (Rescate 20 SP); imidacloprid (Confidor 35 SC, Plural 20 SI); soap sprays (potassium salts of fatty acids, several products); avermectin (Vertimec 1.8 EC); spinosad (Tracer 48 SC, Spintor 12 SC, Spinoace 12 SC)
Afidos, **Aphids** *Myzus persicae*	• Use of yellow or blue sticky traps.	• Integrated crop management. • Crop monitoring before spraying. • Host free periods conserve natural enemies. • Use pesticides only when it necessary after a monitoring program. • Plant away the hosts. • Destroy weeds and host crops as soon as possible, including the head rows. • Application of imidacloprid (Confidor 35 SC, Plural 20 SI); acetamiprid (Rescate 20 SP); pymetrozine (Pymetrozine 50 WG)
21. Hongos ostra, Oyster mushroom		
	• No Data Was Found for This Product with Growers. Samajela Tak Winaq group, a beneficiary group from USAID is making a pilot project for the mushroom production in Chimaltenango.	

ANNEX 2A. GUIDELINES FOR PEST MANAGEMENT PLANS FOR EGP CROPS AND BENEFICIARIES

The following is a PMP guideline produced by analyzing and combining the best pieces of PMPs produced by universities and USDA in the USA, national crop protection services of other countries and international groups. Almost universally, actionable PMPs are crop-specific, *with no more than one crop per PMP*. Each PMP is designed primarily to be used as a seasonal planning and field decision-making (management) tool for farmers and farm managers who produce the crop.

The PMP is outlined roughly into four parts: Justification and Users of PMP, Crop-Specific Information, Pest-Specific Prevention and Management Information, and Pesticide-Specific Information. The last two sections, especially, are to be used and turned into field decision-making tools. PMPs can also be turned into checklists for actionable items, targeting needs and organization of monitoring, record-keeping and reporting.

WHAT IS A PMP?

Pest Management Plans or Guides provide field crop or livestock production decision-makers – farmers and farm managers – with best production practices recommendations, usually adapted by region, crop phenology and seasons. The aims of PMPs are to reduce the risks to production from pests by using a combination of best practices, including IPM, Integrated Vector Management (IVM) and Integrated Weed Management (IWM), that maximize crop or livestock health, and thus resilience to or tolerance of pests, and without an over-reliance on pesticides needed when best practices are not followed. Thus, prevention of pests plays a strongly pivotal role in the PMP, followed closely by management of pests when prevention alone is not adequate for the level of control needed or desired.

WHO ARE THE PMP'S INTENDED AUDIENCES AND USERS?

Farm land preparation and crop production decision-makers

- Farmers
- Farm managers

WHY IS A PMP BEING DONE?

PM Objectives:

- Prevent or reduce pest damage risk to agricultural production
- Protect the health of farmers, farm family members, laborers and community members from pesticide risks
- Maintain economically sound practices
- Reduce environmental pollution and degradation risks

- Enhance the overall quality and quantity of biodiversity on the sustainable farm work environment
- Respond to foreign market demand for the use of agriculture sector best management practice standards, also called Good Agriculture Practices (GAPs) which include IPM measures, to achieve farm and produce certification
- Comply with local, regional, donor and international laws, conventions, and regulations

ORGANIZATION OF THE PMP

The following pieces of crop- or livestock-specific background information are used to build a PMP base

- General information on the crop/livestock
- Crop/livestock common/species names:
- Crop/livestock developmental stages:
- Production regions and how they differ by soil type, pH, fertility, etc
- Overall concerns and priorities for crop/livestock production
- Crop/livestock cultural best practices
- Crop/livestock Good Agriculture Practices (GAPs) including some IPM (see PERSUAP section on GAPS and IPM) recommendations

INDIVIDUAL PEST PREVENTION AND MANAGEMENT

- Invertebrate (Insects, Mites, Slugs/Snails, Nematodes)
- Diseases (Fungi, Bacteria, Viruses, Other)
- Weeds (annual grasses, broadleaves, perennial grasses, broadleaves, sedges, others)
- Vertebrates (birds, rodents, other)

For each pest type, first, identify overall priorities for pest prevention and management in the target crop or livestock.

Next, identify individual pest species noting the type of damage incurred; part of plant damaged: roots/rhizomes/tubers, stems/stalks, leaves, florescence, or seeds (field or stored); or if livestock, part of animal affected.

To best understand how to manage a pest, one needs to understand how, where, when and on what parts of the plant or animal the pest feeds. For field pests and stored grain/food pests, many PMPs are designed and outlined as follows containing the following information, *for each major species of pest (insects, mites, slugs/snails, nematodes)*:

- Photographs of each pest, life stages
- Photographs of plant or livestock damage

- Description of the pest, life cycle and survival strategies[19]:
- Description of damage symptoms
- Best Prevention Practices
    - Use any and all of the above GAPs including IPM
    - Country or region-specific information
- Best Management Practices
    - Focus on prevention (above)
    - Country or region-specific information augmented with international BMPs

INFORMATION ON RECOMMENDED PESTICIDES:

Information needed for each pesticide referenced in the above PMP, by pest (so the farmer/farm manager has the information at their fingertips and do not need to refer to other documents and tables to find it):

- Pesticide essential information needed
    - Active Ingredient (AI) name
    - Product Trade names (with EPA and WHO Acute Toxicity Classifications in parenthesis)
    - Amounts to use per hectare
    - Pre-harvest interval (PHI)
    - Special comments on best application methods and frequency
    - Specialized training/certification/permits for use of RUPs
    - Any resistance management strategies needed
    - Pesticide application record sheet
    - Guidelines for reducing spray drift
    - Re-entry interval (REI): field safe re-entry period after spraying
    - Maximum residue levels (MRL) permitted by markets
- Pesticide precautions with use including
    - Reading the label
    - Legal responsibilities and permitted registration uses
    - Permit requirements for possession and use
    - Recommended and obligated use of PPE and best practices
    - First aid and antidotes
    - Transportation best practices
    - Storage best practices
    - Safe use best practices

[19] Survival strategies: All pests have survival strategies that allow them to live and breed in each crop's farming systems. Knowing the survival strategies, including overwintering habit and alternate host plants, that are employed by the pest can help with decision making at the farming systems-level (e.g. choice of rotation crops) and also can help to anticipate pest outbreaks.

Container disposal best practices

Leftover pesticide disposal best practices

Protection of non-pest animals, plants, endangered species and water body quality

Protect natural enemies & honeybees: http://www.ipm.ucdavis.edu/PMG/r584310111.html

Posting signage in treated fields

Some chemicals not permitted on processed crops

Potential for phytotoxicity (crop injury) on some crops

Documentation and record-keeping on farms

INFORMATION NEEDED ON NATURAL ENEMIES OF PESTS:

Common Names of Predators and Parasitoids effective against above pests: For a list of common natural enemies of crop pests, see http://www.ipm.ucdavis.edu/PMG/NE/index.html. Genera will likely be the same around the world, with different species in different continents, filling similar niches.

ADDITIONAL INFORMATION NEEDED:

Will there be an IPM Coordinator, an IPM Advisory Committee, Education and Licensing for Applicators, Currency and Approval of the PMP?

ANNEX 2B: TEN STEPS FOR UNDERSTANDING AND IMPLEMENTING AN IPM PLAN

An IPM plan is basically a management plan, similar to those in use in the business community. As such, the design of an IPM program can be developed with all of the fundamental parts of any good management plan.

The vital parts of an IPM plan include a definition or understanding of:

- primary beneficiaries(small, medium or large-holder farmers);
- secondary beneficiaries(marketers, processors, transporters, and consumers);
- farm laborers, MAGA extension personnel and EGP field staff;
- national, regional and international organizations involved in production and IPM;
- listed pests or production constraints (problem identification);
- IPM strategies incorporated into a PMP by pest or production constraint (solution planning) over a typical growing season, with available options for first preventing, and if prevention is insufficient, then ramping up management of production constraints.

ELEMENTS OF IPM PROGRAM

Although farmers are likely using numerous IPM tactics, without really calling them that, IPM philosophy or planning is not generally an active part of crop or livestock production in Guatemala; thus, a basic understanding of the steps or elements needed in an IPM program are addressed below.

STEP 1: LEARN AND VALUE FARMERS' INDIGENOUS IPM TACTICS. Most farmers are already using their own forms of GAPs and IPM, many of which are novel, self-created, adapted for local conditions, and many of which work well. These local tools and tactics need to be well understood and taken into account when making PMPs. Accurate assessments of these farmer's GAP and IPM technologies, as well as an understanding of actual losses due to different constraints in farmers' fields are required before designing a crop production and pest management program. S&C farmers will have records of historical pesticide use and trends, as well as information on current use of artisanal or local IPM tactics.

STEP 2: IDENTIFY KEY PESTS FOR EACH TARGET CROP. Although perhaps up to ten species of pests may impact a crop and yields at different plant growth stages, generally only two or three are considered serious enough to spend money controlling. Farmers should be encouraged to monitor their population

size, their life cycle, the kind of damage they cause and actual losses. Note that crop loss figures based on farmers' perceptions of damage and loss are often overestimated.

STEP 3: EVALUATE ALL MANAGEMENT OPTIONS.

Use of best management practices, preventive measures, and "organic" options to control pest impacts may eliminate the need for synthetic pesticides. Below are numerous preventive and management options to choose from.

GAP and IPM options:

Preventive	Preventive	Curative
Soil nutrient, texture and pH testing	Farmer ability to correctly identify pest predators, parasites and diseases	Mechanical insect control by hand picking
Pest resistant/tolerant seed/plant variety	Weekly field scouting to assess pest levels/damage	Farmers make & apply local artisanal plant extracts (neem, pyrethroid, garlic, chili, other)
Early/late plantings or harvestings to avoid pests	Use of trap crops to trap and destroy pests	Weed control by machine cultivation, hoe or hand
Seed treatment with pesticides	Removal/pruning of diseased or heavily infested plants/tree branches	Purchase and use of parasitoids to control major pests
Soil moisture testing	Planting parasite-attracting plants on field margins	Use of pheromone traps to reduce overall pest levels
Raised-bed production or mounding	Inter-planting crops with aromatic herbs (celery, cilantro, parsley, dill) that repel pests	Use of pheromone inundation to confuse pest mating
Irrigation and drip irrigation	Use of pheromone traps to monitor pest levels	Spot treatment of pest hotspots with insecticides, miticides or fungicides
Use of natural fertilizers (manure, compost)	Put baits and use other practices to encourage predator/parasite build-up	Area spraying (complete field coverage) using synthetic and natural insecticides, miticides or nematocides
Use of purchased mineral fertilizers	Mulching with organic materials or plastic to control weeds	Use of synthetic and natural fungicides or bactericides
Combinations of organic and mineral fertilizers	Plant living barriers or bamboo/tree barriers on windward edge of field	Use of herbicides for weed control
Crop rotation	Exclude insect pests by using vegetable tunnels and micro-tunnels	Farm use of a locked storage building for pesticides
Use of green manure crops	Use of biodiversity or energy conservation practices	Farmer use of pesticide trap for mixing pesticide
Farmer ability to correctly identify pests and their damage	Crop stalks, residue and dropped fruit destruction or composting at end of season	Farmer use of receptacle for empty pesticide bottle disposal

STEP 4: CHOOSE IPM METHODS, IDENTIFY NEEDS AND ESTABLISH PRIORITIES.

Continue dialog with project field staff, ministry extension staff and farmers when choosing methods to be used. Consider the feasibility of attractive methods, including the availability of resources needed, farmers' perceptions of pest problems, their abilities to identify pests, their predators, diseases and parasites, and to act upon their observations.

STEP 5: DO EFFECTIVE ACTIVITIES AND TRAINING TO PROMOTE IPM.

Next, identify strategies and mechanisms for fostering the transfer of the needed IPM technology under various project and institutional arrangements, mechanisms, and funding levels. Define what is available for immediate transfer and what may require more adaptation and validation research. Set up an initial planning workshop (with a COP-supported and signed Action Plan) to help define and orient implementation activities, and begin to assign individual responsibilities.

Consider use of the FAO Farmer Field School IPM Protocol:

Learning-by-doing/ discovery training programs

The adoption of new techniques by small-, medium- and large-holder farmers occurs most readily when program participants acquire knowledge and skills through personal experience, observation, analysis, experimentation, decision-making and practice. At first, frequent (usually weekly) sessions are conducted for 10–20 farmers during the cropping season in farmers' fields by trained instructors or extension agents.

Recovering collective memory

Pest problems often emerge because traditional agricultural methods were changed in one way or another, or lost. These changes can sometimes be reversed. This approach uses group discussions to try to identify what changes might have prompted the current pest problem.

Smallholder support and discussion groups

Weekly meetings of smallholders, held during the cropping season, to discuss pest and related problems can be useful for sharing the success of various control methods. However, maintaining attendance is difficult except when there is a clear financial incentive (e.g., credit).

Demonstration project

Subsidized experiments and field trials at selected farms can be very effective at promoting IPM within the local community. These pilots demonstrate IPM in action and allow comparison with traditional synthetic pesticide-supported cultivation.

Educational material

In many countries, basic written and photographic guides to pest identification and crop-specific management techniques are unavailable or out of date. Videos featuring graphic pictures of the effects of acute and chronic pesticide exposure, and interviews with poisoning victims can be particularly effective.

Youth education

Promoting and improving the quality of programs on IPM and the risks of synthetic pesticides has been effective at technical schools for rural youth. In addition to becoming future farmers, these students can bring informed views back to their communities.

Food market incentives (especially important in the last decade)

Promoting Organic, GlobalGAP, BRC, Fair Trade or other certification for access to the lucrative and rapidly growing S&C systems-driven international and regional food markets can be, and is, a strong incentive to adopt IPM.

STEP 6: PARTNER SUCCESSFULLY WITH OTHER IPM IMPLEMENTERS.

The following design steps are considered essential.

Articulate the partnership's vision of IPM

Organizations may forge partnerships based on a common commitment to "IPM" – only to discover too late that that their visions of IPM differ considerably. In fact, the UC Davis definition of IPM (above) is distinctly different from the EU's definition (http://ec.europa.eu/environment/ppps/pdf/ipm.pdf). It is therefore highly important that partners articulate a common, detailed vision of IPM, centered on the crops and conditions the project will encounter.

Confirm partner institutions' commitment

The extent of commitment to IPM integration into project, design, and thus implementation depends strongly upon the following key variables:

- IPM program integration into larger project. The IPM program is likely to be part of a larger "sustainable agriculture" project. The IPM program must fit into a partner's overall goals. The extent of this integration should be clearly expressed in the proposed annual work plan.
- Cost sharing. The extent of funds (or in-kind resources) is a good measure of a genuine partner commitment.
- Participation of key IPM personnel. Organizations should have staff with expertise in IPM. In strong partnerships, these staff members are actively involved in the partnership.

STEP 7: MONITOR THE FIELDS REGULARLY.

At minimum twice a week, farmers should monitor their fields for pests, as some pest populations increase rapidly and unexpectedly; this increase is usually related closely to the stage of crop growth and weather conditions, but it is difficult to predict the severity of pest problems in advance.

STEP 8: SELECT AN APPROPRIATE BLEND OF IPM TOOLS.

A good IPM program draws from and integrates a variety of pest management techniques, like those presented in the above list. Flexibility to fit local needs is a key variable. Pesticides should be used only if no practical, effective, and economic non-chemical control methods are available. Once the pesticide has been carefully chosen for the pest, crop, and environment, it should be applied only to keep the pest population low, not necessarily eliminate it.

STEP 9: DEVELOP EDUCATION, TRAINING, AND DEMONSTRATION PROGRAMS FOR EXTENSION WORKERS.

Implementation of IPM depends heavily on education, training, and demonstration to help farmers and extension workers develop and evaluate the IPM methods. Hands-on training conducted in farmers' fields (as opposed to a classroom) is a must. Special training for extension workers and educational programs for government officials and the public are also important.

STEP 10: MONITORING, RECORD-KEEPING AND EVALUATION (M&E).

Develop data collection forms and checklists, collect baseline GAP/IPM data at the beginning of the project, and set targets.

For the use and maintenance of Good Agriculture Practices (that include safe pesticide storage, use and disposal), maintain farm or project files of: farmer and farm employee training records certification; farm

soil, water, biodiversity, cropping and pesticide use maps; pesticide purchase and stock records; chemical application instructions including target pest, type of chemical applied, dosage, time of spray, rates at which pesticides were applied, harvest interval days, application machinery, PPE required and used, and any special instructions on mixing, exposure to children or dangers.

Further, for project staff, beneficiaries, produce processing facilities, food warehouses, seed multipliers, or farmers that store seed or food and deal with stored seed and food pests, there are warehouse BMPs and monitoring reports that incorporate some IPM tactics. These monitoring forms track, by location or warehouse, use of pallets, stacking, general hygiene and sanitation, damaged packages, actual infestations or signs of rodents, molds, insects, drainage, locks and security measures, use of IPM tactics including least toxic chemicals and strict BMPs for use of common but hazardous fumigants like aluminum phosphide. Examples of forms used for some of these variables are attached as Annex 16.

ANNEX 3: ENVIRONMENTAL ANALYSES OF PESTICIDE ACTIVE INGREDIENTS IN PESTICIDES REGISTERED FOR USE AND IMPORTED TO GUATEMALA

Key: Ecotoxicity (VHT=very highly toxic; HT=highly T; MT=moderate T; ST=Slightly T; PNT=practically not T; NAT=not acutely T)

KC =Known Carcinogen; PC= Possible Carcinogen; ED= Endocrine Disruptor potential; RD= Reproductive or Developmental Toxin potential; P= Parkinson's Disease

Active Ingredients in English and Español	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	fish	bees	Birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
Insecticides/Miticides																
avermectin for mites (abamectina)	microbial extract	yes	no	none	II, III	RD	no data	ST	HT	PNT				HT	VHT	VHT
acephate (acefato)	organophospate	yes	no	III	III	PC	potential	MT	HT	MT	ST	ST		ST		
acetamiprid	chloro-nicotinyl	yes	no	none	III	none	no data	NAT	MT	HT				NAT		
aldicarb (nematodes)	carbamate	yes	**yes**	**Ia**	**I**	ED	known	MT	HT	HT		MT		MT		
alpha cypermethrin (alfametrina)	pyrethroid	**no**	**yes**		II, III	PC	no data	HT	HT	PNT			MT	VHT	VHT	VHT
amitraz	formamdine	yes	no	III	II	PC, RD	no data	MT	PNT	ST	ST			NAT		ST
anilofos	organophospate	**no**		II	III	none	no data	MT		ST				MT		
azadirachtin--neem oil (azadiractina)	botanical	yes	no	none	III	none	no data	ST	NAT	NAT	MT				MT	
Bacillus thuringiensis-BT	microbial	yes	no	none	III	none	no data		PNT	NAT	NAT		ST	ST		
Beauveria basiana	microbial	yes	no	none	III	none	no data									
bendiocarb	carbamate	**no**	**yes**	II	II, III	RD	no data	MT	HT	HT				MT	HT	VHT
beta cyfluthrin (betaciflutrina, ciflutrina)	pyrethroid	yes	**yes**	II	II, III	ED	no data	VHT	HT	PNT			ST		VHT	VHT
beta cypermethrin	pyrethroid	yes	no		II, III	PC	no data	HT	HT	ST				HT		

Active Ingredients in English and Español	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	fish	bees	Birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
bifenthrin	pyrethroid	yes	**yes**	II	II, III	PC, ED, RD	no data	VHT	HT	MT				HT		
bitertanol	Azole	**no**		U		none	no data	MT	PNT	PNT		PNT		MT		MT
buprofezin	IGR	yes	no	U	III	PC	no data	MT	ST	MT	NAT	MT				
cadusafos	organophospate	**no**		**Ib**		none	no data	HT	HT	HT			HT	HT	HT	
carbaryl	carbamate	yes	**some**	II	III	PC, ED	potential	MT	HT	PNT	MT	VHT	ST	HT	HT	MT
Insecticides/Miticides																
carbofuran (carbofurano)	carbamate	yes	**yes**	**Ib**	**I**, II	none	potential	MT	HT	HT	ST	MT	MT	HT	HT	VHT
carbosulfan	carbamate	**no**	no	II	II	none	no data	HT	HT	HT		HT		HT		
chili pepper extract/capsacine	botanical	yes	no		III	none	no data									
chlorantraniliprole (rynaxypyr)	anthranilic diamide	yes	no	none	IV	none	no data	NAT	MT	MT		MT		HT		
chlorfenapyr (clorfenapir)	pyrazole	yes	no	II	III	PC	no data	HT	HT	HT						
chlorpyrifos ethyl (clorpirifos)	organophospate	yes	**yes**	II	II, III	EDED	no data	HT	HT	HT	MT	PNT	MT	VHT	HT	MT
clofentezine for mites (clofentizina)	tetrazine	yes	no	U	III	PC, ED	no data	ST	PNT	ST						ST
clomazone (clomazona)	isoxazolidinone	yes	no	II	III	none	no data	MT	MT	NAT		MT		MT		HT
clothianidin	guanidine	yes	no	none	III	none	no data	ST	HT	ST				ST		
cypermethrin (cipermetrina)	pyrethroid	yes	**yes**	none	II, III	PC	no data	HT	HT	PNT			MT	VHT	VHT	VHT
cyromazine (ciromazina)	triazine	yes	no	U	III	none	known	MT	ST	MT		MT		MT	NAT	
diafenthiuron	unclassified	**no**		U		none	no data	HT	MT	MT		MT		MT		
diazinon	organophospate	yes	**yes**	II	III	RD	potential	MT	HT	VHT	MT	MT	MT	HT	HT	HT
dicofol (mites)	organochlorine	yes	no	III	III	PC, ED	no data	HT	NAT	ST		MT	MT	HT	MT	MT
dimethoate	organophospate	yes	no	II	II	PC	potential	ST	VHT	VHT	HT	MT	VHT	HT	VHT	MT
disulfoton	organophospate	yes	no	**Ia**	**I, II**	none	potential	MT	MT	HT		MT		HT		
endosulfan	organochlorine	**no**	**yes**	II	II	ED	no data	VHT	MT	MT	MT	MT	MT	HT	HT	MT
	endosulfan banned/restricted/cancelled in 57 countries, proposed for POPs and PIC lists															
esfenvalerate (esfenvalerato)	pyrethroid	yes	**yes**	II	II, III	EDED	no data	VHT	HT	ST	VHT		ST	HT		
Insecticides/Miticides																
etofenprox	pyrethroid	yes	no	U	III	PC, ED	no data	HT	HT	MT		MT		HT		
ethoprop(hos) (etoprofos)	organophosphate	yes	**yes**	**Ia**	**I**	KC	potential	MT	MT	HT		MT		MT		
fenbutatin oxide (oxido de fenbutatin)	organotin	yes	**yes**	U	III	ED, RD	no data	VHT	NAT	MT		MT		HT		VHT
fenamiphos	organophospate	yes	**yes**	**Ib**	**I**	none	potential	HT	HT	HT		MT		VHT		MT
fenpropathrin (fenpropathrin)	pyrethroid	yes	**yes**	II	II, III	ED	no data	VHT			VHT				VHT	VHT
fenpyroximate for mites (fenpiroximato)	pyrazole	yes	no		II	none	no data	HT	MT	MT		MT		HT		

Active Ingredients in English and Español	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	fish	bees	Birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
fipronil	pyrazole	yes	**yes**	II	II, III	PC, ED	potential	HT	HT	HT					HT	HT
flufenoxuron	benzoylurea	**no**	no	U	III	none	no data	HT	MT	MT		MT				
garlic extract/allicin (extracto de ajo)	botanical	yes	no		III	none	no data	VHT	HT	HT	MT	MT	MT	VHT	VHT	ST
kaolin clay (caolinita)	inorganic	yes	no	none	III	none	no data									
imidacloprid	chloro-nicotinyl	yes	no	II	II, III	none	potential	NAT		MT					VHT	
indoxacarb	oxadiazine	yes	no	none	III	none	no data	MT	HT	HT		NAT		MT		
lambda cyhalothrin (cihalotrina, mites)	pyrethroid	yes	**yes**	II	II, III	ED	no data	VHT	HT	PNT		VHT	VHT	VHT	VHT	
d-limonene	citrus extract	yes	no		III	none	no data	MT						MT	ST	
lufenuron	benzoyl urea	yes	no	none	III	none	no data	MT	ST	MT		MT		HT	ST	
malathion (malathion)	organophospate	yes	no	III	II, III	PC, ED	potential	MT	HT	MT	HT	ST	VHT	MT	VHT	HT
methamidophos	organophospate	yes	**yes**	**Ib**	**I**	none	potential	ST			ST			VHT		MT
	methamidophos banned/restricted/canceled in 13 countries, including Guatemala; PIC chemical															
methiocarb (metiocarb)	carbamate	yes	**yes**	**Ib**	**I, III**	none	potential	HT	HT	MT	MT	MT	MT	MT	HT	HT
methomyl (metomil)	carbamate	yes	**yes**	**Ib**	**I, III**	ED	potential	MT	HT	HT	ST	HT	ST	HT	VHT	HT
Insecticides/Miticides																MT
methoxyfenozide	diacylhydrazine	yes	no	U	III	none	potential	MT	MT	ST		ST			HT	HT
methyl parathion (metil paration)	organophospate	**no**	**yes**	**Ia**	**I, II**	PC, ED	potential	MT	HT	HT	MT	MT	ST	HT	VHT	
mineral oil (aceite mineral)	petroleum	yes	no	none	III	none	no data	NAT								
naled	organophospate	yes	**yes**	II	**I**	RD	potential	MT	HT	HT				HT		
narrow range dormant oil (aceite parafinico)	paraffin oil	yes		no	none	III	none	no data	NAT							
neem oil (aceite de neem)	botanical	yes	no	none	III	none	no data	ST	NAT	NAT	MT				MT	
novaluron	benzoyl urea	yes	no	none	II, III	none	no data	MT	MT	MT		MT		HT		
nuclear polyhedrosis virus (NPV)	microbial	yes	no	none	IV	none	no data									
oxamyl (oxamil, nematocide)	carbamate	yes	**yes**	**Ib**	**I**	none	no data	ST	HT	VHT		HT		ST		MT
oxydemeton methyl (oxidemeton metil)	organophospate	yes	**yes**	**Ib**	**I, II**	RD	potential	ST	HT	HT		MT		MT	HT	HT
Paecilomyces lilacinus	microbial	yes	no	none	III	none	no data	MT						MT		
Paecilomyces fumosoroseus	microbial	yes	no	none	III	none	no data									
permethrin (permetrina)	pyrethroid	yes	**yes**	II	III	PC, ED	no data	VHT	VHT	PNT	ST	ST	ST	VHT	MT	MT
phorate (forato)	organophospate	yes	**yes**	**Ia**	**I**	none	potential	HT	HT	HT		MT	ST	MT	VHT	VHT
phosphamidon (fosfamidon)	organophospate	**no**	**yes**	**Ia**	**I**	PC, ED	potential	NAT	HT	HT	NAT	HT	ST	HT	HT	VHT
	phosphamidon on PIC list; banned/restricted or canceled in 11 countries; not legal for import to 46 countries															

Active Ingredients in English and Español	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	fish	bees	Birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
phoxim	organophospate	**no**	no	II	none	none	no data	HT	HT	PNT	MT			VHT	VHT	VHT
pymetrozine (pimetrozina)	triazine	yes	no	III	III	PC	potential	MT	ST	MT		MT		MT		
pyrethrin (piretrina)	botanical extract	yes	**yes**	II	III	PC	no data	HT	HT	ST		MT		HT		
pirimiphos-methyl	organophospate	yes	no	III	III	none	no data	MT	HT	MT						
pyriproxyfen (piriproxifen)	IGR (JH mimic)	yes	no	U	II, III	none	no data	MT	MT	MT		MT		MT		VHT
profenofos	organophospate	yes	**yes**	II	II, III	none	potential	HT						VHT	VHT	VHT
Insecticides/Miticides											HT					
propargite (mites)	unclassified	yes	no		III	PC, RD	no data	HT	PNT					NAT		HT
protiofos	organophospate	**no**		II	III	none	no data	MT		MT				HT		
pymetrozine	triazine	yes	no	III	III	PC	potential	MT	ST	MT		MT		MT		
spinosad	microbial	yes	no	U	III	none	no data	MT	HT	PNT		ST			HT	MT
spiromesifen	tectronic acid	yes	no	none	III	none	no data	HT	ST	ST		MT				
sulfluramid-miticide (sulfluramida)	sulfonamid	yes	no	III	III	none	no data	MT						MT		
teflubenzuron	IGR	**no**		U	IV	none	no data	ST	MT	MT	ST	HT	HT	HT	HT	HT
terbufos	organophospate	yes	**yes**	**Ia**	**I**	none	no data	VHT	MT	MT		HT		VHT		VHT
terbuthylazine (terbutilazina)	triazine	yes	no	U	III	none	no data	MT	MT	MT		MT		MT		HT
d-tetramethrin (tetrametrina)	pyrethroid	yes	no	U	III	PC, ED	no data	VHT	HT	NAT					HT	MT
thiacloprid (tiacloprid)	chloro-nicotinyl	yes	no	II	II	PC	no data		MT	ST		MT			VHT	ST
thiamethoxam (tiametoxam)	neonicotinoid	yes	no		III	PC	no data	PNT	HT	PNT		PNT	PNT	PNT	PNT	
thiodicarb (tiodicarb)	carbamate	yes	no	II	II	PC	no data	MT	MT	PNT			MT	VHT		HT
thiocyclam (tiociclam)	nereistoxin	**no**		II	none	none	no data	HT				MT		MT		
triazophos (triazofos)	organophospate	**no**		**Ib**	none	none	no data	HT	MT	HT		MT		HT		
Trichoderma harzianum	microbial	yes	no	U	III	none	no data									
zeta cypermethrin (zetacipermetrina)	pyrethroid	yes	**yes**	**Ib**	II, III	PC, ED	no data	VHT	VHT	NAT		NAT	VHT	VHT	VHT	
Herbicides																
2 4 D	chlorophenoxy	yes	no	II	III	PC, ED	potential	ST	HT	MT	ST	NAT	NAT	NAT	ST	ST
2 4 D amine (2,4-D amina)	chlorophenoxy	**no**		none	none	PC	no data									
2 4 D isopropylamine salt (isopropilamina)	chlorophenoxy	yes	no	none	II, III	PC	potential	NAT						NAT		
acetochlor (acetoclor)	chloroacetanilide	yes	**yes**	III	II, IIII	KC, ED	potential	MT	MT	ST		MT				MT
alachlor (alaclor)	chloroacetanilide	yes	**yes**	III	II, III	KC, ED, RD		MT	NAT	NAT	MT		MT	ST		ST
ametryne (ametrina)	triazine	yes	no	III	III	ED	potential	ST	MT	NAT	MT		MT			ST

Active Ingredients in English and Español	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	fish	bees	Birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
aminopyralid (aminopiralid)	pyridine	yes	no	none	III	none	potential	MT	MT	MT		MT		MT		MT
atrazine	triazine	yes	no	U	III	PC, ED	known	ST	NAT	PNT	ST	ST	ST	ST	ST	ST
bentazon	benzothiazinone	yes	no	III	III	none	no data	NAT	MT	MT		MT	ST	MT		
bromacil	Uracil	yes	no	U	II, III, IV	PC, ED	known	NAT	MT	NAT				ST		ST
butachlor (butaclor)	chloroacetanalid	**no**		U	III	PC	no data	HT	MT	NAT	MT		MT	MT	HT	MT
butralin	dinitroaniline	yes		III	III	none	no data	HT	MT	NAT		MT		MT		VHT
carfentrazone ehtyl (carfentrazone etil)	triaolinone	yes	no	III	III	none	no data	ST	NAT	NAT		MT		MT		MT
clethodim (cletodim/n)	Cyclohexenone	yes	no	none	II, III	none	potential	MT	MT	MT		MT		MT		
cyanazine (cyanazina)	triazine	**no**		II	II, III	PC, ED, RD	known	ST	MT	MT		MT	ST	MT		HT
dicamba	a benzoic acid	yes	no	III	II, III	RD	potential	ST			NAT			NAT		ST
difenoconazole (difenoconazol)	Azole	yes	no	III	III	PC	no data	MT	MT	ST		MT		MT		HT
Herbicides																
diuron	Urea	yes	no	U	III	KC	known	ST			ST		ST	ST	MT	ST
ethephon	organophospate	yes	no	U	III	none	no data	NAT	MT	MT		MT		NAT	NAT	NAT
ethoxysulfuron	sulfonylurea	**no**		none	none	none	no data	MT	ST	MT		MT				
fluazifop-p-butyl	propionic acid	yes	no	III	II, III	none	no data	MT	ST	PNT					ST	
flurochloridone (flurocloridona)	unclassified	**no**		U	none	RD	potential	MT	MT	NAT		MT		MT		
fluroxypyr (fluroxipir)	unclassified	yes	no	none	III	none	no data	MT	MT	MT		MT		MT		HT
fluroxypyr methyl/meptyl (fluroxipir-meptyl)	pyridine	yes		U	mixture	none	no data	MT	MT	MT		MT		HT		HT
glufosinate ammonium (glufosinato amonio)	unclassified	yes	no	none	II, III	none	no data	NAT	NAT	MT		MT		NAT		ST
glyphosate (glifosato)	phosphonoglycine	yes	no	U	II, III	none	potential	ST	ST	NAT		PNT		MT		ST
glyphosate, isopropylamine salt (glifosato)	phosphonoglycine	yes	no	none	II, III	none	potential	ST			ST	NAT	ST	NAT	NAT	NAT
glyphosate trimesium (glifosato trimesium)	phosphonoglycine	**no**		none	none	none	potential	NAT								ST
halosulfuron-methyl (metil)	pyrazole	yes	no	U	III	none	potential	ST	MT	ST		ST		ST		NAT
haloxyfop(-P-)methyl (metil)	a propionic acid	**no**		none		KC	no data	HT	MT	MT				MT		
hexazinone	triazinone	yes	no	III	III	none	known	NAT	MT	NAT				NAT	ST	ST
hydramethylnon	unclassified	yes	no	III	III	PC, RD	no data	HT	MT	MT				MT		
imazamox	imidazolinone	yes	no	none	III	none	no data	NAT								
imazapic	imidazolinone	yes	no	none	III	none	no data	MT	MT	NAT				MT		
imazapyr (imazapir)	imidazolinone	yes	no	U	III	none	no data	ST	MT	ST		MT		NAT		

Active Ingredients in English and Español	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	fish	bees	Birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
imazaquin	imidazolinone	yes	no	U	II, III	none	no data	NAT	MT	NAT		MT		MT		
imazethapyr (imazetapir)	amidazolinone	yes	no	U	II, III	none	potential	NAT	HT	NAT		NAT		NAT		
isoxaflutole	isoxazole	yes	**yes**		KC	KC	no data	ST	MT	ST		MT		MT		MT
linuron	Urea	yes	no	U	III	KC, ED, RD	potential	MT	NAT	MT		MT	ST	MT	ST	MT
	linuron banned/restricted/canceled in 2 countries															
Herbicides																
sulfentrazone	aryl triazolinone	yes	no		III	none	no data	ST	MT	MT				MT		MT
terbuthylazine (terbutilazina)	triazine	yes	no	U	III	none	no data	MT	MT	MT		MT		MT		HT
terbutryne (terbutrina)	triazine	**no**	no	U	II, III	PC	potential	MT	NAT	NAT		MT		MT		
thiazopyr	pyridine	yes	no	none	II, III	PC, ED	potential	MT	MT	MT		MT		MT		MT
thiobencarb	thiocarbamate	yes	no	II	III	none	potential	MT	ST	NAT	MT		MT	MT	MT	MT
triclopyr (triclopir)	chloropyridinyl	yes	no	III	II, III	none	no data	MT			NAT				ST	
trifloxysulfuron (sodium)	sulfonylurea	yes	no	none	III	none	no data									
trifluralin (trifluralina)	dinitroanaline	yes	no	U	II, III	PC, ED	no data	HT	PNT	PNT	MT	HT	ST	ST	ST	MT
Fungicides																
acibenzolar-s-methyl	benzothiadiazole	yes	no	III	III	none	potential	MT	MT	MT		MT		MT		
azoxystrobin (azoxistrobina)	Strobin	yes	no	U	III	none	potential	MT	MT	MT		MT		MT		VHT
azufre (sulfur)	Inorganic	yes	no	U	III	none	no data	NAT	NAT	NAT	NAT					NAT
Bacillus subtilis	bacterial	yes	no	U	III, IV	none	no data	NAT	ST	NAT		NAT		NAT		
benomyl/benlate (benomil)	benzimidazole	**no**	no	U	III	PC, ED	no data	HT	PNT	MT	ST	HT		NAT		ST
Bordeaux mixture	inorganic	**n**	no	III		none	no data	HT	MT	MT		MT		MT		
boscalid (nicobifen)	carboximide (anilide)	yes	no	none	II, III	PC	no data	MT	MT	MT		MT		MT		
bromuconazole	Azole	yes	no	II	II, III	none	no data	MT	MT	ST		ST	MT	MT	MT	
carboxin	carboxamide	yes	no	U	II, III	RD	no data	MT	MT	ST		MT		NAT		
chloroneb (cloroneb)	substituted benzene	yes			III	none	no data	MT		NAT				MT		
	chlorineb on WHO obsolete pesticide list															
chlorothalonil (chlorothalonil)	unclassified	yes	no	none	I, II	PC	potential	VHT			HT		ST	VHT	MT	MT
copper carbonate	Inorganic	**no**	no	none	none	none	no data	HT				MT				
copper (cobre metalico)	Inorganic	yes	no	none	II, III	none	no data	MT			VHT	HT	HT	MT		HT
copper hydroxide	inorganic	yes	no	II	II, III	none	no data	HT	MT	MT		MT	HT	NAT	HT	HT
copper oxide (oxido de cobre)	inorganic	**no**		none	I, III	none		NAT								

Active Ingredients in English and Español	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	fish	bees	Birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
copper oxychloride (oxicloruro de cobre)	inorganic	yes	no	none	II, III	none	no data	MT	MT	MT		MT				
copper sulfate (sulfato de cobre)	Inorganic	yes	no	II	III	none	no data	MT	HT	PNT	HT	HT	VHT	ST		ST
cyclosulfamuron	sulfanyl urea	**no**		U	none	none	no data	MT	MT	MT		MT		MT		
cymoxanil	unclassified	yes	no	III	III	none	no data	MT	MT	ST		MT		MT	MT	ST
Fungicides																
cyproconazole (ciproconazol)	Azole	yes	no	III	III	PC	no data	MT	MT	MT		MT				MT
dazomet	unclassified	yes	no	III	III	none	potential	ST	PNT	ST		MT		HT		HT
dichlofluanid (diclofluanida)	sulphamide	**no**	no	U	none	none	no data	HT	MT	NAT		MT	MT	MT		VHT
dicloran	chlorophenyl	yes	no	U	II, III	none	potential	ST	MT	MT		MT		MT		MT
dichlorophene (dicloropropeno)	chlorinated phenol	**no**	no	III	III	PC, RD	no data	HT		NAT			MT	MT		
dimethomorph (dimetomorf)	morpholine	yes	no	U	III	none	no data	MT	MT	MT		MT				ST
diquat (dibromide)	bipyridylium	yes	no	none	III	none	potential	NAT	NAT	MT	NAT		MT	ST		ST
dodemorph (didemorf)	morpholine	**no**		U	none	none	no data	MT						MT		
edifenphos (edifenfos)	organophospate	**no**		**Ib**		none	no data	MT		MT				HT		
epoxiconazol	triazole	**no**		none	none	PC	no data	MT	MT	MT		MT				
etridiazole (terrazole)	Azole	yes	no	III	III	KC, ED	no data	MT		MT	ST					MT
famoxadone	unclassified	yes	no	U	III	none	no data	HT	MT	ST				HT		
febuconazole	triazole	yes	no	U	III	PC, ED	potential	ST	PNT	ST			HT	HT	VHT	HT
fenoxaprop-p-ethyl	propionic acid	yes	no	none	II, III	none	no data	MT	ST	PNT		ST		MT		MT
fenpropimorph	morpholine	**no**		III	**I**	none	no data	MT	MT	MT		MT		MT		
fentin hydroxide (hidroxido)	organotin	yes	**yes**	II	**I**	KC, ED, RD	no data	MT	MT	HT		MT	HT	NAT		VHT
fludioxonil	phenylpyrrole	yes	no	U	III	none	potential	MT	MT	MT		MT		MT		
fluopicolide	benzamid	yes			III	none	no data	MT	MT	NAT		MT		MT		
folpet	thiophthalimide	yes	no	U	II, III	KC	no data	HT	PNT	ST	HT	MT	ST	HT		MT
Fungicides																
fomesafen	diphehyl ether	yes		III	**I,** II	PC	no data	NAT	MT	NAT		MT		NAT		ST
fosetyl aluminum	unclassified	yes	no	none	III	none	potential	NAT	ST	ST		MT		NAT		MT
imazalil	imidazole	yes	no	II	II, III	PC, RD	no data	MT	NT	PNT						
imazalil sulfate (imazalil sulfato)	Azole	yes	no	none	**I**	none	no data									
iminoctadine tris (albesilate)	guanidine	**no**		II	none	None	no data			MT						
iprodione (iprodione)	dicarboximide	yes	no	U	III	PC	potential	MT	NAT	ST				HT		
iprovalicarb	unclassified	**no**		U	none	PC	no data	MT	ST	MT		MT				

Active Ingredients in English and Español	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	fish	bees	Birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
isoprothiolane (isoprotiolano)	phosphorothiolate	**no**	no	III	III	none	no data	MT		ST	ST			MT		
mancozeb	dithiocarbamate	yes	no	U	III	PC, ED, RD	no data	MT	MT	ST	HT					NAT
mandipropamide	mandelamide	yes	no	none	III	none	no data	MT	NAT	MT		MT				
maneb	carbamate	**no**	no	U	III	KC, ED, RD	no data	MT	NAT	PNT	ST			ST		HT
(methyl) thiophannate (metil tiofanato)	benzamidazole	yes	no	U	III	PC, RD	potential	MT	PNT		NAT			ST		
metiram	dithiocarbamate	yes	no	U	III	PC, RD	no data	ST	PNT	ST		MT		MT		MT
myclobutanil (miclobutanil)	Azole	yes	no	III	III	RD	no data	MT	ST	MT		MT		MT		HT
ofurace	Anilide	**no**		U	none	none	no data	MT	MT	NAT						
paraquat	bipyridylium	yes	**yes**	II	II	PC	potential	ST	NAT	MT	ST		ST	ST	NAT	ST
pencycuron	Urea	**no**		U	IV	none	no data	HT	MT	MT		MT		MT		
Fungicides																
pyrimethanil (pirimetanil)	anilinopyrimidine	yes	no	U	III	PC, ED	no data	MT		PNT	MT		MT	MT	MT	
prochloraz (procloraz)	Azole	**no**		III	none	PC	no data	MT	NAT	MT		MT		MT		
propineb	dithiocarbamate Zn	**no**		U		RD	no data	MT	PNT	PNT			MT	MT	MT	MT
pyraclostrobin	Strobin	yes	no	none	II, III	none	no data	ST	MT	MT		MT		HT		
pyrazophos	phosphorothiolate	**no**		II	none	none	no data	MT	HT	MT	ST	MT	MT		HT	VHT
spiroxamine (spiroxamina)	unclassified	yes	no	II	III	none	no data	MT	MT	MT		MT		MT		
sulfur (azufre)	Inorganic	yes	no	U	III	none	no data	NAT	NAT	NAT	NAT					NAT
TCMTB (busan)	Mercaptobenzothiazole	yes	no	none	**I**	PC	no data	VHT					ST			VHT
tebufenozide	diacylhydrazine	yes	no	U	III	none	potential	MT	ST	ST		MT			HT	MT
thiabendazole (tiabendazol)	Azole	yes	no	U	III	PC	no data	ST	NAT		MT	ST				ST
thiram (tiram)	carbamate	yes	no	III	III	ED, RD	no data	HT	NAT	PNT	VHT	HT		NAT	HT	HT
tolylfluanid (tolifluanida)	sulfamide	**no**		U		PC	no data	MT	LT	HT		MT				
Trichoderma harzianum	microbial	yes	no	U	III	none	no data									
tridemorph (tridemorf)	morpholine	**no**		II	none	none	no data	MT	ST	MT	VHT	MT				
Fungicides																
trifloxistrobin (trifloxistrobin)	Strobin	yes	no	none	III	none	no data	ST	ST	MT		MT				
triforine (triforina)	piperazine	yes	no	U	II, III	R, D toxin	no data	NAT	MT	NAT		MT		MT		
Ziram	dithiocarbamate	yes	no	III	III	PC, ED, RD, P	no data	HT	NAT	MT	HT		MT			HT

Active Ingredients in English and Español	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	fish	bees	Birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
Nematocides																
aldicarb	carbamate	yes	**yes**	**Ia**	**I**	ED	known	MT	HT	HT		MT		MT		
fenamiphos	organophospate	yes	**yes**	**Ib**	**I**	none	potential	HT						VHT		MT
fosthiazate (fostiazato)	organophospate	yes	**yes**	none	**I, II**	none	no data	ST	HT	HT		MT				HT
metam sodium	dithiocarbamate	yes	**yes**	II	**I**	PC, RD		MT	MT	MT		VHT		VHT		
methyl bromide (bromuro de metilo)	halogenated organic	yes	**yes**	none	**I**	RD	no data	MT	PNT		MT	MT	MT	MT	MT	MT
Myrothecium verrucaria	microbial	yes	no	none	III	none	no data									
oxamyl	carbamate	yes	**yes**	**Ib**	**I**	none	no data	ST	HT	VHT		HT		ST		MT
tomatillo oil + thyme oil extracts (Promax)	soil biopesticide	exempt		none	none	no data										
Fumigants																
aluminum phosphide (fosfuro de aluminio)	inorganic	yes	***yes***	none	**I**	none	no data	HT	HT	HT				MT		
chloropicrin (cloropicrina)	unclassified	yes	***yes***		II	none	potential	VHT				MT		HT		
magnesium phosphide (fosfuro magnesio)	inorganic	yes	***yes***		**I**	none	no data	MT		HT		MT				
metam sodium	dithiocarbamate	yes	***yes***	II	**I**	PC		MT	MT	MT		VHT		VHT		HT
						RD										
methyl bromide (bromuro de metilo)	halogenated organic	yes	***yes***	none	**I**	RD	no data	MT	PNT		MT	MT	MT	MT	MT	MT
zinc phosphide (fosfuro de zinc)	inorganic	yes	***yes***	**Ib**	**I**, II, III	RD	no data	HT	VHT	HT						
Rodenticides																
brodifacoum (brodifacouma)	coumarin	yes	no	**Ia**	III	none	no data	MT				MT				
bromethaline (brometalina)	unclassified	yes	no	**Ia**	II, III	none	no data	HT		HT						HT
cumatetralyl	coumarin	**no**		**Ib**	**I**	none	no data	MT		MT						MT
diphacinone (difacinona)	1,3-Indandione	yes	no	**Ia**	II, III	none	no data	MT		ST						ST
flocoumarfen	coumarin	**no**		**Ia**	none	none	no data	HT		MT						MT
Salmonella entiriditis	microbial	**no**	no	none	none	none	no data									
zinc phosphide	inorganic	yes	**yes**	**Ib**	**I**, II	RD	no data	HT	VHT	HT						
Molluscicides																
metaldehyde (metaldehido)	aldehyde	yes	**yes**	II	II, III	PC	potential	NAT	PNT	MT	PNT	PNT	PNT	PNT	PNT	PNT

Active Ingredients in English and Español	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	fish	bees	Birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
iron phosphate	inorganic	yes	no	none	III	none	no data									
Disinfectants (used for processing fruits and vegetables, clean-up)																
chlorine (cloro)	inorganic	yes	no	none	**I**	none	no data	HT			MT	MT	HT	HT	HT	HT
formaldehyde	organic	yes	no	none	**I**	KC	no data	NAT					NAT	NAT		ST
sodium hydroxide (hidroxido de sodio)	Base	yes	no	none	II, III	none	no data	NAT								
tea tree *Melaleuca alternifolia* oil	botanical	**no**	no	none	none	none	no data									
Bacteriocides																
gentamycin sulfate (sulfato de gentamicina)	antibiotic	**no**	no	none	none	none	no data									
kasugamycin	antibiotic	**no**	no	U	none	none	no data	ST			ST		MT		ST	ST
oxytetracycline HCl (oxitetraciclina)	carboxamide	yes	no	none	III	RD	no data	NAT	MT	NAT				NAT		
streptomycin sulfate (sulfato de estreptomicina)	antibiotic	yes	no	none	III	RD	no data	NAT								
Other																
cytokinins (citoquinina, plant growth reg)	botanical	yes	no	none	III	none	no data	NAT								
flumetralin (flumetralina, plant growth reg)	dinitroaniline	yes	no	U	I, II	none	no data	VHT		MT		MT		HT		VHT
nonyl phenol (adjuvant)	organic	yes	no	none	none	ED	no data	HT				HT	MT	HT		VHT
ethylene oxide (óxido de etileno)	sterilant					KC, RD										
harpin proteins (proteina harpin)	resistance elicitor	yes	no	none	III	none	no data									
paclobutrazol (plant growth reg)	triazole	yes	no	III	II, III	none	no data	MT	MT	NAT		MT		MT		
Ripening agents used for processing fruits and vegetables																
calcium carbide (carburo de calcio)	inorganic	**no**	no	none	none	none	no data									
ethylene gas (etilen)	organic	yes	no	none	**I**	RD	no data	ST								

ANNEX 4. PERSONS CONSULTED

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ANNEX 5. TABLE OF PESTICIDES NOT RECOMMENDED OR PROHIBITED FROM USE ON USAID/GUATEMALA-SUPPORTED PROJECTS (WITH REASON)

Insecticides not to be used on USAID projects

alpha cypermethrin (alfametrina) (not EPA registered)	aldicarb (RUP, Class I, systemic for long period in crop)
anilofos (not EPA registered)	bendiocarb (not EPA registered, RUP)
beta cyfluthrin (betaciflutrina, ciflutrina) (RUP only for use on cotton)	bifenthrin (RUP only for use on cotton)
bitertanol (not EPA registered)	cadusafos (not EPA registered, RUP)
carbofuran (carbofurano) (RUP, Class I)	carbosulfan (not EPA registered)
chlorpyrifos ethyl (clorpirifos) (RUP)	cypermethrin (cipermetrina) (RUP)
deltamethrin (deltametrina) (RUP only for use on cotton)	diafenthiuron (not EPA registered)
diazinon (RUP)	disulfoton (Class I)
emamectin benzoate (RUP only for 4-epimethlyamino-4-deoxykavermectin BLA and B1b benzoates)	endosulfan (not EPA registered, RUP, proposed POPs list)
esfenvalerate (esfenvalerato) (RUP only for 66% EC formulations)	ethoprop(hos) (etoprofos) (RUP, Class I)
fenamiphos (RUP, Class I)	fenbutatin oxide (oxido de fenbutatin) (RUP)
fenpropathrin (RUP only for 2.4% EC formulations)	fipronil (RUP)
flufenoxuron (not EPA registered)	lambda cyhalothrin (cihalotrina) (RUP)
methamidophos (RUP, Class I, PIC list)	methiocarb (metiocarb) (RUP, Class I)

methomyl (metomil) (RUP, Class I)	methyl parathion (metil paration) (not EPA registered, RUP, Class I)
naled (RUP, Class I)	oxamyl (oxamil, nematocide) (RUP, Class I)
oxydemeton methyl (oxidemeton metil) (RUP, Class I)	permethrin (permetrina) (RUP)
phorate (forato) (RUP, Class I)	phosphamidon (fosfamidon) (not EPA registered, RUP, Class I, on PIC list)
phoxim (not EPA registered)	profenofos (RUP)
protiofos (not EPA registered)	pyrethrins (botanical extract, piretrina) (RUP only for EC formulations)
teflubenzuron (not EPA registered)	terbufos (RUP, Class I)
thiocyclam (tiociclam) (not EPA registered)	triazophos (triazofos) (not EPA registered, Class I)
zeta cypermethrin (zetacipermetrina) (RUP, Class I)	

Herbicides not to be used on USAID projects

2 4 D amine (2,4-D amina) (amine form not EPA registered)	acetochlor (acetoclor) (RUP)
alachlor (alaclor) (RUP)	butachlor (butaclor) (not EPA registered)
cyanazine (cyanazina) (not EPA registered)	ethoxysulfuron (not EPA registered)
flurochloridone (flurocloridona) (not EPA registered)	glyphosate trimesium (glifosato trimesium) (trimesium form not EPA registered)
haloxyfop(-P-)methyl (metil) (not EPA registered)	isoxaflutole (RUP)
MAA, methane arsonic acid (not EPA registered)	oxadiargyl (oxadiargil) (not EPA registered)
paraquat (RUP)	picloram (RUP)
piperofos (not EPA registered)	pyrazosulfuron ethyl (pirazosulfuron etil) (not EPA registered)
profoxydim (profoxidim) (not EPA registered)	propamocarb (not EPA registered)
propaquizafop (not EPA registered)	terbutryne (terbutrina) (not EPA registered)

Fungicides not to be used on USAID projects

benomyl/benlate (benomil) (not EPA registered)	Bordeaux mix (no EPA-registered products sold in USA; however, all ingredients to make Bordeaux are registered, and recommended by UC Davis for artesenal use)
copper carbonate (not EPA registered)	copper oxide (oxido de cobre) (not EPA registered)
cyclosulfamuron (not EPA registered)	dichlofluanid (diclofluanida) (not EPA registered)
dazomet (Basamid 97 MG) (RUP)	dodemorph (didemorf) (not EPA registered)
dichlorophene (dicloropropeno) (not EPA registered)	epoxiconazol (not EPA registered)
edifenphos (edifenfos) (not EPA registered, Class I)	fentin hydroxide (hidroxido) (RUP, Class I)
fenpropimorph (not EPA registered, Class I)	iminoctadine tris (albesilate) (not EPA registered)
imazalil sulfate (imazalil sulfato) (Class I)	isoprothiolane (isoprotiolano) (not EPA registered)
iprovalicarb (not EPA registered)	ofurace (not EPA registered)
maneb (no longer EPA registered)	pencycuron (not EPA registered)
paraquat (RUP)	propineb (not EPA registered)
prochloraz (procloraz) (not EPA registered)	TCMTB (busan) (Class I)
pyrazophos (not EPA registered)	tridemorph (tridemorf) (not EPA registered)
tolylfluanid (tolifluanida) (not EPA registered)	

Nematocides not to be used on USAID projects

aldicarb (RUP, Class I)	fenamiphos (RUP, Class I)
fosthiazate (fostiazato) (RUP, Class I)	metam sodium (RUP, Class I)
methyl bromide (bromuro de metilo) (RUP, Class I Montreal Protocol chemical)	oxamyl (RUP, Class I)

Fumigants not to be used on USAID projects

aluminum phosphide (fosfuro de aluminio) (RUP, Class I)—only to be used by highly-trained & protected spray personnel	chloropicrin (cloropicrina) (RUP)
magnesium phosphide (fosfuro de magnesio) (RUP, Class I)	metam sodium (RUP, Class I)
methyl bromide (bromuro de metilo) (RUP, Class I, Montreal Protocol chemical)	zinc phosphide (fosfuro de zinc) (RUP, Class I)

Rodenticides not to be used on USAID projects

(most rodenticides are formulated as rodent baits, which reduces risks to humans)

cumatetralyl (not EPA registered, Class I)
flocoumarfen (not EPA registered, Class I)
zinc phosphide (RUP, Class I)

Molluscicide not to be used on USAID projects

metaldehyde (metaldehido) (RUP)

Disinfectant not to be used on USAID projects

tea tree *Melaleuca alternifolia* oil (not EPA registered)

Bacteriocides not to be used on USAID projects

gentamycin sulfate (sulfato de gentamicina) (not EPA registered)
kasugamycin (not EPA registered)

Fruit Ripening Chemicals not to be used on USAID projects

calcium carbide (carburo de calcio) (not EPA registered)
ethylene gas (etilen) (Class I)

ANNEX 6. TOXICITY OF PESTICIDES: EPA AND WHO CLASSIFICATIONS

General Toxicity

Pesticides, by necessity, are poisons, but the toxicity and hazards of different compounds vary greatly. Toxicity refers to the inherent intoxicating ability of a compound whereas hazard refers to the risk or danger of poisoning when the pesticide is used or applied. Pesticide hazard depends not only on toxicity but also on the chance of exposure to toxic amounts of the pesticide. Pesticides can enter the body through oral ingestion, through the skin or through inhalation. Once inside the body, they may produce poisoning symptoms, which are either acute (from a single exposure) or chronic (from repeated exposures or absorption of smaller amounts of toxicant).

EPA and WHO Toxicity Classifications

Basically, there are two systems of pesticide toxicity classification. These are the USEPA and the WHO systems of classification. It is important to note that the WHO classification is based on the active ingredient only, whereas USEPA uses product formulations to determine the toxicity class of pesticides. So, WHO classification shows relative toxicities of all pesticide active (or technical) ingredients, whereas EPA classification shows actual toxicity of the formulated products, which can be more or less toxic than the active ingredient alone and are more representative of actual dangers encountered in the field. The tables below show classification of pesticides according to the two systems.

a) USEPA classification (based on formulated product = active ingredient plus inert and other ingredients)

Class	Descriptive term	Mammalian LD_{50}		Mammalian Inhalation LC_{50}	Irritation		Aquatic invert/fish (LC_{50} or EC_{50})[2]	Honey bee acute oral (LD_{50})
		Oral	Dermal		Eye[1]	Skin		
I	Extremely toxic	≤50	≤200	≤0.2	Corrosive	Corrosive	< 0.1	
II	Highly toxic	50-500	200-2000	0.2-2.0	Severe	Severe	0.11-1.0	< 2 µg/bee
III	Moderately toxic	500-5000	2000-20000	2.0-20	No corneal opacity	Moderate	1.1-10.0	2.1-11 µg/bee
IV	Slightly toxic	≥5000	≥20000	≥20	None	Moderate or slight	10.1-100	
	Relatively non-toxic						101-1000	
	Practically non-toxic						1001-10,000	> 11 µg/bee
	Non-toxic						> 10,000	

[1] Corneal opacity not reversible within 7 days for Class I pesticides; corneal opacity reversible within 7 days but irritation persists during that period for Class II pesticides; no corneal opacity and irritation is reversible within 7 days for Class III pesticides; and Class IV pesticides cause no irritation

[2] Expressed in ppm or mg/l of water

b) WHO classification (based only on active or 'technical' ingredient)

Class	**Descriptive term**	**Oral LD_{50} for the rat (mg/kg body wt)**		**Dermal LD_{50} for the rat (mg/kg body wt)**	
		Solids	**Liquids**	**Solids**	**Liquids**
Ia	Extremely hazardous	≤5	≤20	≤10	≤40
Ib	Highly hazardous	5-50	20-200	10-100	40-400
II	Moderately hazardous	50-500	20-2000	100-1000	400-4000
III	Slightly hazardous	≥501	≥2001	≥1001	≥4001
U	Unlikely to present acute hazard in normal use	≥2000	≥3000	-	-

ANNEX 7. NATURAL PESTICIDES

Natural Pesticides: Extracts of naturally-occurring plants, spices, oils, fatty acids, insect growth regulator (IGR) mimics, induced resistance elicitors, minerals, microbes or microbial extracts registered for use in Guatemala, and registered by US EPA (see Annex 3)

Insecticides

azadirachtin--neem oil (azadiractina)	botanical extract
Bacillus thuringiensis-BT	microbial
Beauveria basiana	microbial
garlic extract/allicin (extracto de ajo)	botanical extract
harpin protein (proteina harpin)	plant induced resistance elicitor
kaolin clay (caolinita)	inorganic
d-limonene	citrus extract
narrow range dormant oil (aceite parafinico)	parafin oil
neem oil (aceite de neem)	botanical extract
nuclear polyhedrosis virus (NPV)	microbial
Paecilomyces lilacinus	microbial
Paecilomyces fumosoroseus	microbial
pyrethrin (piretrina)	botanical extract
pyrethrum (pyrethrins mix)	botanical extract
pyriproxyfen (piriproxifen)	IGR (Juvenile Hormone mimic)
spinosad	microbial extract
buprofezin	IGR (Chitin Synthesis inhibitor)

Fungicides

azufre (sulfur)	inorganic
Bacillus subtilis	microbial
Bordeaux mixture	inorganic (Bordeaux ingredients EPAregistered)
copper (cobre metalico)	inorganic
copper hydroxide	inorganic
copper oxychloride (oxicloruro de cobre)	inorganic
copper sulfate (sulfato de cobre)	inorganic
harpin protein (proteina harpin)	plant induced resistance elicitor
sulfur (azufre)	inorganic

Nematocides

Myrothecium verrucaria	microbial
tomatillo oil + thyme oil extracts (Promax)	botanical + spice extracts – soil biopesticide

Molluscicide

iron phosphate	inorganic

ANNEX 8. BOTANICAL PESTICIDES, REPELLENTS, AND BAITS REGULATED BY USEPA

Name	Other Names	Use	Toxicity	EPA Tracking Number
Allium sativum	Garlic	Repels insects	Low	128827
Allyl isothiocyanate	Oil of Mustard	Kills & repels insects	Questionable	004901
Anise Oil	Repels vertebrates	Low	004301	
4-allyl anisole	Estragole	Kills beetles	Low	062150
Azadirachtin	*Azadirachta indica* Neem tree extract	Kills & repels insects	Low, IV	121701
Bergamot		Repels vertebrates		129029
Canola Oil	*Brassica Napus B. Campestris*	Kills many insects	Low	011332
Capsaicin	*Capsicum frutescans*	Repels vertebrates	Low, III	070701
Castor Oil		Repels vertebrates	Low	031608
Cedarwood Oil		Repels moth larvae	Low	040505
Cinnamaldehyde	*Ceylon and Chinese* cinnamon oils	Kills insects, fungi & repels vertebrates*	Low	040506
Citronella Oil		Repels insects & vertebrates	Low	021901
Cloves, Crushed			Low	128895
Dihydroazadirachtin	Neem tree extract *Azadirachta indica*	Kills & repels insects	III-IV	121702
Eucalyptus Oil		Repels insects, mites fleas & mosquitoes	Low	040503
Eugenol	Oil of cloves	Kills insects**	Low	102701
Geraniol	Oil of rose isomeric w/ linalool	Repels vertebrates**	Low	597501
Geranium Oil			Low	597500
Indole	from all plants	Trap bait: corn rootworm beetles	Low	25000-
Jasmine Oil			Low	040501
Jojoba Oil		Kills & repels whitefly kills powdery mildew	Low	067200
Lavandin Oil		Repels clothes moth	Low	040500
Lemongrass		Repels vertebrates	Low	040502
Linalool	Oil of Ceylon isomeric w/geraniol	Repels insects, ticks, mites & spiders	Low	128838
Maple lactone		Roach trap bait	Low	004049

Methyl salicylate	Oil of wintergreen	Repels moths, beetle & vertebrates	May be Toxic in large quantity	76601-
Mint	Herb	Kills aphids	Low	128892
Mint Oil		Kills aphids	Low	128800
Mustard Oil		Repels insects, spiders & vertebrates	Low	004901
Neem Oil		Kills whitefly, aphids	Low	025006
1-Octen-3-ol	From clover, alfalfa	Trap bait: mosquitoes	Low	69037-
Orange		Repels vertebrates	Low	040517
p-Methane-3,8 diol	*Eucalyptus sp.*	Repels biting flies, mosquitoes	Low	
2-Phenylethyl-propionate	From peanuts	Kills insects, ticks, mites & spiders	Low	102601
Pyrethrum	*Chrysanthemum sp.*	Stored products use	III	
Red pepper	Chili	Repels insects	Low	070703
Rosemary	Herb		Low	128893
Rotenone	*Derris sp., Tephrosia*	Controls ticks	III	
Ryania	*Ryania speciosa*	Kills thrips, codling moth, corn borers		
Sabadilla	*Schoenocaulon sp.*		III	
Sesame Oil	*Sesamum indicum*	Pyrethroid synergist	Low	
Soybean Oil	Soja	Kills insects, mites	Low	031605
Thyme	Herb	Controls aphids	Low	128894
1,2,4 Trimethoxy-benzene	From squash	Trap bait: corn rootworm, cucumber beetles	Low	40515-
Verbenone	From pine trees	Repels bark beetles	Low	128986

* attracts corn rootworm beetles, ** attracts Japanese beetles. Not all plant extracts are listed. More detailed information available for most of the oils: http://www.epa.gov/pesticides/reregistration/status.htm. Natural Source: Only one or a few sources are listed. Most of these chemicals are found in many different plants.

ANNEX 9. GENERAL MITIGATION OF POTENTIAL PESTICIDE DANGERS GENERAL MEASURES TO ENSURE SAFE USE

If there are no feasible alternatives to pesticides, take the following measures to mitigate and reduce their risks to human health and the environment. Note that risk is a function of both toxicity and exposure. Reducing risk means (1) selecting less toxic pesticides and (2) selecting pesticides that will lead to the least human exposure before, during and after use.

REDUCE EXPOSURE TIME OR THE DEGREE OF EXPOSURE BEFORE USING

BEFORE PURCHASE, TRANSPORT, STORAGE, OR USE

- Provide appropriate training to all relevant parties
- Training should be continuous
- Training should identify level and audiences: distributors, farmers, transporters, etc.

PACKAGING:

- follow international and national norms and guidelines
- use packaging (small containers) adapted to local needs
- eliminate re-use of packaging materials

TRANSPORT:

- understand pesticide-specific risks and conditions to avoid prior to transport – understand constraints on package label
- separate pesticides from other materials being transported
- secure containers in transport vehicles to prevent loss, leakage, or damage
- avoid intense exposure to sunlight for extended periods – see pesticide-specific guidance

STORING:

- develop strict guidelines for village-level storage
- ensure permanent, well-marked labeling
- follow and respect national norms
- use appropriate language and approved pictograms

FORMULATING:

- use appropriate type and concentration
- use appropriate personal protective equipment

BEFORE USE

- Ensure evacuation of non-essential personnel, especially children and pregnant women
- Ensure that appropriate environmental conditions for application exist – see pesticide-specific guidance (e.g., avoid windy or rainy conditions

DURING USE

- Use proper application equipment:

Should be adapted to user needs and possibilities
Should assure maintenance and availability of parts and service

- Use protective equipment and clothing:

Should be adapted to local climatic conditions
Should be adapted to user needs and resource possibilities
Should eliminate exposure rather than just reduce it, if at all possible

FOCUS ON "BUFFER ZONES" AROUND THE FOLLOWING:

- housing
- environment: water, sensitive areas
- children's play areas

AFTER USING

- know, enforce, respect exclusion or reentry periods after application
- ensure proper cleaning and rinsing of applicators' preparation and application equipment, applicators' clothing, and storage containers
- develop a workable monitoring and evaluation system for:
- Adhere to national and international policies regarding pest management and pesticides regarding:
    - health effects on applicators, the local population, and domestic animals,
    - efficacy on target pests
    - impacts on environment: residuals in and/or manifest damage/degradation to above- and below-ground water, soils, air, non-targeted environment, biodiversity
    - build-up of residual levels leading to resistance by targeted pests
    - elimination/minimization of pesticide leftovers and proper disposal of containers

Website: http://pdf.usaid.gov/pdf_docs/PNADK154.pdf, Chapter 13 by A. Schroeder

ANNEX 10. EPA RECOMMENDED WORKER PROTECTION STANDARDS

HANDLER PPE FOR WORKER PROTECTION STANDARD PRODUCTS				
Route of Exposure	**Toxicity Category by Route of Exposure of End-Use Product**			
	I DANGER	**II WARNING**	**III CAUTION**	**IV CAUTION**
Dermal Toxicity or Skin Irritation Potential[1]	Coveralls worn over long-sleeved shirt and long pants Socks Chemical-resistant footwear Chemical-resistant Gloves[2]	Coveralls worn over short-sleeved shirt and short pants Socks Chemical-resistant footwear Chemical-resistant Gloves2	Long-sleeved shirt and long pants Socks Shoes Chemical-resistant Gloves[2]	Long-sleeved shirt and long pants Socks Shoes No minimum4
Inhalation Toxicity	Respiratory protection device[3]	Respiratory protection device[3]	No minimum[4]	No minimum[4]
Eye Irritation Potential	Protective eyewear[5]	Protective eyewear[5]	No minimum[4]	No minimum[4]

[1] If dermal toxicity and skin irritation toxicity categories are different, PPE shall be determined by the more severe toxicity category of the two. If dermal toxicity or skin irritation is category I or II, refer to the pesticide label/MSDS to determine if additional PPE is required beyond that specified in the Table.

[2] Refer to the pesticide label/MSDS to determine the specific type of chemical-resistant glove.

[3] Refer to the pesticide label/MSDS to determine the specific type of respiratory protection.

[4] Although no minimum PPE is required for these toxicity categories and routes of exposure, some specific products may require PPE. Read pesticide label/MSDS.

"Protective eyewear" is used instead of "goggles" and/or "face shield" and/or "shielded safety glasses" and similar terms to describe eye protection. Eye glasses and sunglasses are not sufficient eye protection.

The following sites identify recommended PPE for pesticides:

http://www.epa.gov/oppfead1/safety/workers/equip.htm (all types of PPE)

ANNEX 11. ROUTES OF PESTICIDE EXPOSURE AND MITIGATION OF RISKS

Kind of exposure to avoid	Means of avoiding overexposure
Dermal (skin) exposure	Check the label for special instructions or warnings regarding dermal exposure Use recommended protective clothing and other equipment as listed on the label Do not re-enter the area until deposit has dried or re-entry interval is past
Oral (mouth) exposure	Check the label for special instructions or warnings regarding oral exposure Never eat, drink, or smoke, chew tobacco while working with any pesticide Wash thoroughly with soap and water before eating, drinking, smoking, or chewing tobacco Do not touch lips to contaminated objects (such as nozzles) Do not wipe mouth with contaminated hands or clothing Do not expose food, beverages, drinking vessels, or cigarettes to pesticides Wear a face shield when handling concentrated pesticides
Respiratory (lungs) exposure	Read the label to find out if respiratory protection is required If respiratory protection is required, use only an approved respiratory device Stay upwind during application
Eye exposure	Read the label to find out if eye protection is required If eye protection is required, use goggles to protect eyes or a face shield to protect eyes and face Keep pesticide container below eye level when pouring

ANNEX 12. BASIC FIRST AID FOR PESTICIDE OVEREXPOSURE

Get medical advice quickly if you or any of your fellow workers have unusual or unexplained symptoms during work or later the same day. Do not let yourself or anyone else get dangerously sick before calling a physician or going to a hospital. It is better to be too cautious than too late.

First aid is the initial effort to help a victim while medical help is on the way. If you are alone with the victim, make sure the victim is breathing and is not being further exposed to the poison before you call for emergency help. Apply artificial respiration if the victim is not breathing.

Read the first aid instructions on the pesticide label, if possible, and follow them. Do not become exposed to poisoning yourself while you are trying to help. Take the pesticide container (or the label) to the physician. Do not carry the pesticide container in the passenger space of a car or truck.

Poison on skin	➢ Act quickly ➢ Remove contaminated clothing and drench skin with water ➢ Cleanse skin and hair thoroughly with detergent and water ➢ Dry victim and wrap in blanket.
Chemical burn on skin	➢ Wash with large quantities of running water ➢ Remove contaminated clothing ➢ Cover burned area immediately with loose, clean, soft cloth ➢ Do not apply ointments, greases, powders, or other drugs in first aid treatment of burns
Poison in eye	➢ Wash eye quickly but gently ➢ Hold eyelid open and wash with gentle stream of clean running water ➢ Wash for 15 minutes or more ➢ Do not use chemicals or drugs in the wash water; they may increase the extent of injury
Inhaled poison	➢ Carry victim to fresh air immediately ➢ Open all doors and windows so no one else will be poisoned ➢ Loosen tight clothing ➢ Apply artificial respiration if breathing has stopped or if the victim's skin is blue. If patient is in an enclosed area, do not enter without proper protective clothing and equipment. If proper protection is not available, call for emergency equipment from your fire department
Poison in mouth or swallowed	➢ Rinse mouth with plenty of water ➢ Give victim large amounts (up to 1 quart) of milk or water to drink ➢ Induce vomiting only if instructions to do so are on the label
Procedure for inducing vomiting	➢ Position victim face down or kneeling forward, Do not allow victim to lie on his back, because the vomit could enter the lungs and do additional damage ➢ Put finger or the blunt end of a spoon at the back of victim's throat or give syrup of ipecac ➢ Collect some of the vomit for the physician if you do not know what the poison is ➢ Do not use salt solutions to induce vomiting
When *not* to induce vomiting	➢ If the victim is unconscious or is having convulsions ➢ If the victim has swallowed a corrosive poison. A corrosive poison is a strong acid or alkali. It will burn the throat and mouth as severely coming up as it did going down. It may get into the lungs and burn there also ➢ If the victim has swallowed an emulsifiable concentrate or oil solution. Emulsifiable concentrates and oil solutions may cause severe damage to the lungs if inhaled during vomiting

Website: http://pdf.usaid.gov/pdf_docs/PNADK154.pdf, Chapter 13 by A. Schroeder

ANNEX 13. INTERNATIONAL PIC & POPS LISTS

Updated (2007) PIC Pesticides and Industrial Chemicals (http://www.pic.int)

PIC Chemicals as of 2007 (41 chemicals: 24 pesticides, 6 severely hazardous pesticide formulations and 11 industrial chemicals)

2,4,5-T
aldrin
asbestos (crocidolite)
asbestos (actinolite, anthophyllite, amosite, and tremolite)
binapacryl
captafol
chlordane
chlordimeform
chlorobenzilate
DDT
dieldrin
dinitro-ortho-cresol
dinoseb
1,2-dibromoethane
DNOC and its salts
ethylene dichloride
ethylene oxide
fluoroacetamide
heptachlor
hexachlorobenzene
hexachlorocyclohexane
lindane
mercury compounds
methamidophos
methyl-parathion
monocrotophos (2002)
parathion
pentachlorophenol
phosphamidon
polybrominated biphenyls (PBB)
polychlorinated biphenyls (PCB)
polychlorinated terphenyls (PCT)
tetraethyl lead
tetramethyl lead
toxaphene
tris (2,3 dibromopropyl) phosphate
mixtures of benomyl, carbofuran and thiram (sold as Granox TBC & Spinox T, which are risk-prone seed treatments manufactured and used in West Asia)

Updated POPs Pesticides and Chemicals (http://www.pops.int)

Pesticides

Aldrin

Chlordane

*Dichloro-Diphenyl-Trichloroethane (*DDT)*

Dieldrin

endrin – *not on PIC list*

heptachlor

hexachlorobenzene

mirex – *not on PIC list*

toxaphene

Industrial Chemical

Polychlorinated Biphenyls (PCBs)

Combustion Products

Dioxins – *not on PIC list* (formed by burning chlorine-based hydrocarbon chemical compounds, like any of the above chemicals)Furans – *not on PIC list* (formed by burning pentose compounds, especially plastics)

* DDT may continue to be used for malaria control in interior residual spraying (IRS)

STOCKHOLM – POPs, Stockholm Convention on Persistent Organic Pollutants (POPs) was adopted in 2001 and entered into force in 2004, 151 Signatories, 110 Parties; U.S. is a signatory and supports POPs but has not yet ratified it Governments will take measures to eliminate or reduce the production, sale and use of POPs.

ANNEX 14. PESTICIDE DISPOSAL OPTIONS

Pesticide Disposal

If you end up with excess pesticide concentrate, dilute it as directed on the label; then apply it to an area listed on the label. Do not apply more than is recommended. You can also store leftover pesticide until you are able to take it to a hazardous-waste collection site.

An "empty" pesticide container is not clean; a significant amount of pesticide residue can remain inside of it. Triple-rinse an empty container of liquid pesticide before you toss it into the trash. Here's how: First, when you are down to the last amount of pesticide concentrate, drain the pesticide container into your spray tank for at least 30 seconds.

Fill the empty container one-fifth to one-fourth full of water and rinse thoroughly. Use this rinse water as dilution water for the pesticide concentrate in the sprayer. If the dilution rate allows you to pour all the rinse water into the sprayer, drain it into the sprayer for at least 30 seconds.

Follow the procedure in Steps 2 and 3 two more times. Then spray the pesticide mixture on areas listed on the label. Do not exceed the label's application rate.

Container Disposal

All empty pesticide containers must be returned to the distributor, recycled by a qualified party, or destroyed, but never re-used for any other purpose than pesticide containment. Recycling by the distributor/manufacturer should be the first choice, if feasible. It is extremely dangerous to use them for anything else. Consult the pesticide label, the manufacturer, or the manufacturer's representative for specific recommendations regarding container cleanup and disposal. The following are general guidelines. There are two basic methods for cleaning pesticide containers prior to disposal. Both require that the container be turned upside down and allowed to drain into the spray tank for at least 30 seconds, followed by adding water to the container and rotating it well to wet all surfaces, then draining it again into the spray tank as an additional dilutent.

- Triple Rinse Method: Add a measured amount of water or other specified dilutent so that the container is one-fifth to one-fourth full. Rinse container thoroughly, pour into a tank, and allow it to drain for 30 seconds. Repeat three times. The water rinsate can be used to mix with or dilute more of the same pesticides or it can be sprayed on the target crop.

- Pesticide Neutralization Method: Empty organophosphate and carbamate containers can be neutralized by adding alkaline substances. The following procedure is recommended for 200-liter barrels. Use proportionally less material for smaller containers.

1. Add 20 liters of water, 250 milliliters of detergent, and one kilogram of flake lye or sodium hydroxide.
2. Close the barrel and rotate to wet all surfaces.
3. Let stand for 15 minutes.

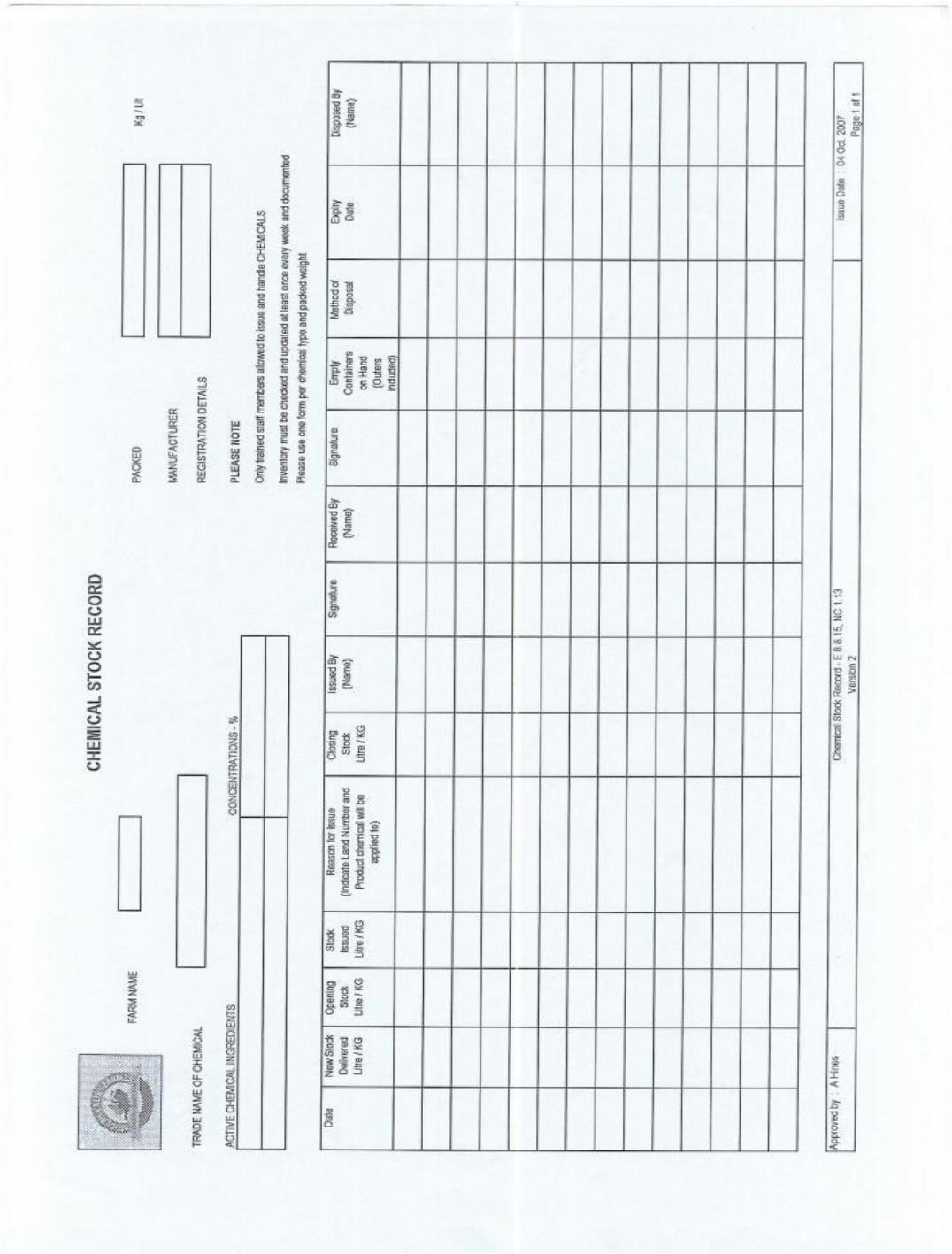
4. Drain completely and rinse twice with water. The rinsate should be drained into a shallow pit in the ground located far away from wells, surface water, or inhabited areas.

Containers cleaned by any of the above methods are still not safe to use for any other purpose. Glass containers should be broken and plastic or metal containers punctured or crushed. Containers can then be buried in an isolated area at least 50 cm below ground surface.

Container Type	Disposal Statements
Metal Containers (non-aerosol)	Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of container in a sanitary landfill, or by other procedures approved by state and local authorities.
Paper and Plastic Bags	Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.
Glass Containers	Triple rinse (or equivalent). Then dispose of in a sanitary landfill or by other approved state and local procedures.
Fiber Drums with Liners	Completely empty liner by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of liner in a sanitary landfill or by incineration if allowed by state and local authorities. If drum is contaminated and cannot be reused, dispose of it in the manner required for its liner.
Plastic Containers	Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.
Compressed Gas Cylinders	Return empty cylinder for reuse (or similar wording).
Foil outer pouches of water soluble packets (WSP)	Dispose of the empty outer foil pouch in the trash, as long as WSP is unbroken.

Website: http://www.epa.gov/oppfead1/labeling/lrm/chap-13.pdf

ANNEX 15. RECORD KEEPING ASSOCIATED WITH PESTICIDE



CHEMICAL STOCK RECORD

FARM NAME

TRADE NAME OF CHEMICAL

ACTIVE CHEMICAL INGREDIENTS

CONCENTRATIONS - %

PACKED

Kg / Lt

MANUFACTURER

REGISTRATION DETAILS

PLEASE NOTE

Only trained staff members allowed to issue and handle CHEMICALS

Inventory must be checked and updated at least once every week and documented

Please use one form per chemical type and packed weight

Date	New Stock Delivered Litre / KG	Opening Stock Litre / KG	Stock Issued Litre / KG	Reason for Issue (Indicate Land Number and Product chemical will be applied to)	Closing Stock Litre / KG	Issued By (Name)	Signature	Received By (Name)	Signature	Empty Containers on Hand (Outers included)	Method of Disposal	Expiry Date	Disposed By (Name)

Approved by : A Hines

Chemical Stock Record - E.8.8.15, NC 1.13
Version 2

Issue Date : 04 Oct. 2007
Page 1 of 1

CHEMICAL APPLICATION INSTRUCTIONS - JOVAC

DATE | PRODUCT

LAND NUMBER | BLOCK NUMBER

CHEMI CHEMICAL PRODUCT(S) TO BE APPLIED	ACTUAL DOSAGE PER LAND	Water Vol.	Har. Int. day	Target	INSTRUCTIONS FOR APPLICATION

APPLICATION MACHINERY TO BE USED | Foliar Application

INSTRUCTION GIVEN BY (NAME) | SIGNATURE

WHO EXECUTED THE INSTRUCTION

NAME | SIGNATURE | Time of Spray Start | Finish

SUITABLE AND CLEAN PROTECTIVE CLOTHING

Gloves | Boots | Raincoa | Overall | Nose/ Mouth | Respirator | Eye Pro.

SPECIAL INSTRUCTIONS WHEN HANDLING CHEMICALS

Handling Dry Concentate | Handling Liquid Conc. | Water After Use | Keep Locked No Children | Chemical Are Dangero.

PROTECTIVE CLOTHING ISSUED TO

Name		Name		Name	
Signature		Signature		Signature	
Name		Name		Name	
Signature		Signature		Signature	

WAS THERE EXCESS SPRAY MIX? YES | NO

APPROXIMATE QUANTITY ____ Liters

WHAT HAVE YOU DONE WITH THE EXCESS SPRAY MIX? | EXECUTED BY (NAME)

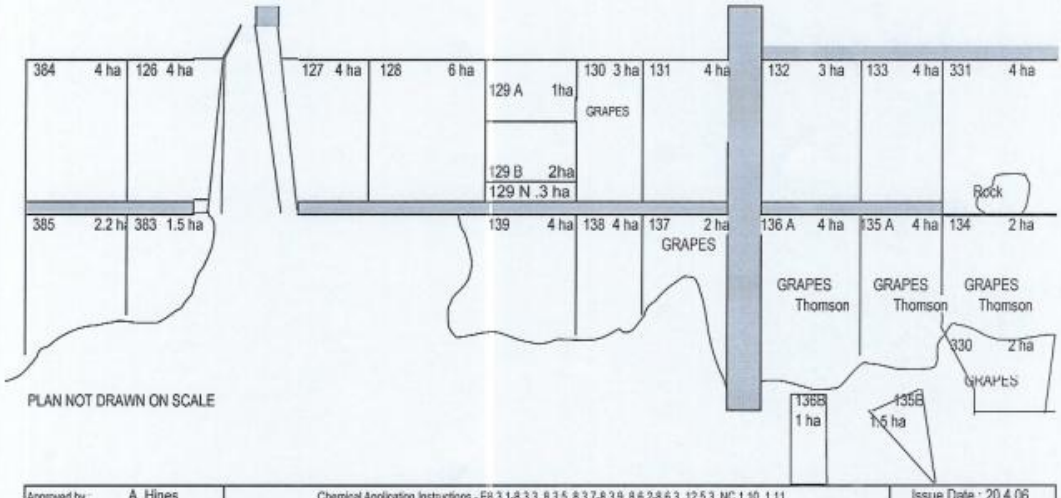
Spray Washing YES / NO

Lit of water

Location: Washing Disposal Area

Weather Conditions

Rain	Dry	Clody	Tempture	Sunny	Wind YES / NO



PLAN NOT DRAWN ON SCALE

Approved by : A .Hines Pepared by : E .Nair	Chemical Application Instructions - E8.3.1-8.3.3, 8.3.5, 8.3.7-8.3.9, 8.6.2-8.6.3, 12.5.3, NC 1.10, 1.11 Version 9	Issue Date : 20.4.06 Page 1 of 1

1.- Control Card for Pesticides Use.- This card will stay with farmer, to keep a record on the use of pesticide by crop.

Save the Children

CONTROL FORM FOR THE USE OF PERTICIDES

GENERAL DATA			
FARMERS NAME			
Community:	**Municipality:**	**Province:**	**Altitude:**
USE OF PESTICIDES - 1st TREATMENT			
CROP:		**SURFACE:**	
Pest to be treated	Name of material	Date and time of application	Quantity used
Environmental conditions:			
Justification for use			
Other recommended control measures			
Result of application			
NAME AND SIGNATURE OF IG AND NRM SUPERVISOR:			
USE OF PESTICIDES - 2nd TREATMENT			
CROP:		**SURFACE:**	
Pest to be treated	Name of material	Date and time of application	Quantity used
Environmental conditions:			
Justification for use			
Other recommended control measures			
Result of application			
NAME AND SIGNATURE OF IG AND NRM SUPERVISOR:			

ANNEX 16. HORTIFRUTI PERMITTED PESTICIDES

FOR STRAWBERRY (FIRST 2 PAGES) AND LETTUCE (THIRD PAGE)

WAL*MART CENTROAMERICA

hortifruti

LISTADO DE PLAGUICIDAS PERMITIDOS HORTIFRUTI GUATEMALA

PROVEEDORES	Cooperativa Rincon Grande
	Anibal Morales
	Samajela Winak
	Juan Carlos Campollo
	Fruvelz
Departamento	Chimaltenango

Cultivo	Fresa

REALIZADO	15/08/2008
VERSION	1
VALIDO HASTA	15/08/2009

NOMBRE COMERCIAL	INGREDIENTE ACTIVO	CONTROL	Dosis Max/ha	Dosis max por 100 L	Restricciones de Uso	Volumen L /ha	Intervalo a Cosecha	Intervalo de Reingreso	PPM	Uso
Dynamec 1,8 EC/Vertimec	Abamectin	Minador de la Hoja, araña roja	0.25 L	50 mls		800	10 dias	2 horas	0,02 mg/kg	INSECTICIDA
Dibrom	Naled	Mosca blanca, Afidos, Thrips Minador		300 cc		400	1 dia	24 horas	1 mg/kg	INSECTICIDA
Lannate 90 sp	Metomil	Larvas de Lepidoptera,	0.5 kg			400	7 dias	24 horas	2 mg/kg	INSECTICIDA
Malathion 50 EC	Malathion	Afidos, Thrips,	2.8 L			600	10 dias	24 horas	8 mg/kg	INSECTICIDA
ok 0,15 EC / ACT Botanico / Nembac	Azadirectin	Afidos, Thrips	1 L	100 mls		600	1 dia	2 horas	n/a	INSECTICIDA BIOLOGICO
Dipel 2x / Javelin / Delfin 6.4 WP	B.T	Larvas de Lepidoptera	0.5 Kg	50 gms		600	0 dias	0 horas	n/a	INSECTICIDA BIOLOGICO
Thuricide HP	B.T	Larvas de Lepidoptera	1.0 kg	100 gms		600	0 dias	0 horas	n/a	INSECTICIDA BIOLOGICO
Xentari	B.T aizawai	Larvas de Lepidoptera	1.0 kg	100 gms		600	0 dias	0 horas	n/a	INSECTICIDA BIOLOGICO
BB Plus	Beauveria bassiana	Afidos, Thrips, Mosca Blanca	1 kg	100 gms		800	0 dias	0 horas	n/a	INSECTICIDA BIOLOGICO
Diazinon	Diazinon	Minador, Afidos, Thrips, Larvas de lepidoptera	0.7 L			400	7 dias	24 horas	0.5 mg/kg	INSECTICIDA
Brigade 480 EC	Bifenthrin	Thrips	1.0L	200 mls		800	5 dias	12 horas	0.5 mg/kg	INSECTICIDA
Talstar 100 EC	Bifenthrin	Thrips	0.4L	40 mls		600	5 dias	12 horas	0.5 mg/kg	INSECTICIDA
Sevin 80 WP	Carbard	Larvas de Lepidoptera, Trhips	2 kg			600	8 dias	24 horas	10 mg/kg	INSECTICIDA
Lorsban Vexter	Clorpirifos	Larvas de Lepidoptera	1.5 L			400	30 dias	24 horas	0.2 mg/kg	INSECTICIDA
Thiodan	Endosulfan	Afidos, Mosca Blanca, Larvas de Lepidoptera	2 L			400	4 dias	8 horas	2 mg/kg	INSECTICIDA
Confidor 200 SL	Imidacloprid	Mosca blanca, Afidos	0.5 L	50 mls		600	4 dias	12 horas	0.5 mg/kg	INSECTICIDA
Gaucho	Imidacloprid	Afidos , Complejo de plagas del suelo	8mls / kg	n/a	miento de Semillas Unicamante		n/a	12 horas	0.5 mg/kg	INSECTICIDA
Jade 0.8 GR	Imidacloprid	mplejo de plagas del Suelo y gusanos cortado	16 kgs	n/a	Usar en Trasplante	n/a	28 dias	12 horas	0.5 mg/kg	INSECTICIDA
Hydrasol	Jabon	Afidos y minadores de hoja	7.0 L	700 mls		600	0 dias	0 horas	n/a	INSECTICIDA BIOLOGICO
Tracer 20 SC	Spinosad	Larvas de Lepidoptera, Thrips, Minadores	0.3 L	30 mls	Max 2 aplicaciones	800	1 dia	4 horas	1 mg/kg	INSECTICIDA BIOLOGICO
Tracer 480 SC / Spinoace	Spinosad	Larvas de Lepidoptera, Thrips, Minadores	0.2 L	20 mls	Max 2 aplicaciones	800	1 dia	4 horas	1 mg/kg	INSECTICIDA BIOLOGICO
Actara 25 WG	Thiamethoxam	Thrips , Mosca Blanca , Afidos	150 gms	20 gms		600	7 dias	4 horas		INSECTICIDA
Cruiser	Thiamethoxam	Plagas del suelo	Tratamiento a Semilla	n/a		0	42 dias	4 horas	n/a	TRATAMIENTO DE SEMILLA
DC tron Plus	Aceite mineral	Afidos, Thrips	5 l	500 mls		600	1 dia	2 horas	n/a	INSECTICIDA BIOLOGICO
Ortiva 250 SC / Amistar 250	Azoxystrobin	Roya	0.5 L	60 mls	Max 3 aplicaciones	600	14 dias	4 horas	1 mg/ kg	FUNGICIDA
Sentry P / Subsol	Bacillus Subtilis	Roya, Botrytis	5.0 L		Aplicar con volumen alto de agua	600	0 dias	4 horas	n/a	FUNGICIDA BIOLOGICO
Phyton	Sulfato de Cobre	Infecciones Foliares	1.2 L	200 ml		600	0 dias	0 horas	n/a	FUNGICIDA
Aliete 80 WG	Fosetil-Al	Tizon, Mildiun , Damping off	2 kg			600	7 dias	24 horas	78 mg/kg	FUNGICIDA
Cop Trace	Copper acetate	Infecciones bacterianas	1.5 L	200 mls		600	4 dias	2 horas	n/a	FUNGICIDA

ADMINISTRACION DE RIESGOS HORTIFRUTI GUATEMALA

Ing Agr. Sergio Torres Garcia

WAL★MART CENTROAMERICA

horti fruti

LISTADO DE PLAGUICIDAS PERMITIDOS HORTIFRUTI GUATEMALA

PROVEEDORES	Cooperativa Rincon Grande
	Anibal Morales
	Samajala Winak
	Juan Carlos Campollo
	Fruvetz

Cultivo	Fresa

REALIZADO	15/08/2008
VERSION	1
VALIDO HASTA	16/08/2009

Departamento	Chimaltenango

NOMBRE COMERCIAL	INGREDIENTE ACTIVO	CONTROL	Dosis Mza/ha	Dosis max por 100 L	Restricciones de Uso	Volumen L /ha	Intervalo a Cosecha	Intervalo de Reingreso	PPM	Uso
Kocide DF / Funguran OH	Hidroxido de Cobre	Infecciones bacterianas	3 Kgs	300 gms		600	4 dias	4 horas	n/a	FUNGICIDA
ox 50 WP/ Cupravit / Copper Oxychl	Oxicloruro de cobre	Infecciones bacterianas	3 kgs	300 gms		600	3 dias	4 horas	n/a	FUNGICIDA
r oxychloride/ Cupro Cuffaro micro 37	Oxicloruro de cobre	Infecciones bacterianas	3 Kgs / 1.5 kgs	90g / 25 gms		600	3 dias	0 horas	n/a	FUNGICIDA
Nordox	Oxido cuprico	Infecciones bacterianas	1.5 kgs	150 gms		600	10 dias	4 horas	n/a	FUNGICIDA
Rovral 250 Flowable	Iprodione	Botrytis	2.0 L	200 mls		800	10 dias	4 horas	5 mg / kg	FUNGICIDA
Rovral 50 SC / WP	Iprodione	Botrytis	1.0 L	100 mls		800	10 dias	4 horas	5 mg / kg	FUNGICIDA
Sporekill	Amonio Cuaternario	Roya, Infecciones bacteriales	1.0 L	125 mls		600	0 dias	0 horas	n/a	FUNGICIDA BIOLOGICO
Thievit 80 WP/ Thievit Jet / Kumulus	Azufre	Mildiun Polvoriento	3.0 kgs	300 gms		600	1 dia	2 horas	n/a	FUNGICIDA
Mormidomil	Metalaxil	Mildiun Velloso, Phytroptora		1.2 L		600	7 dias	48 horas	10 mg/kg	FUNGICIDA
Rovral	Iprodione	Botrytis	1.5 kg				14 dias	24 horas	15 mg/kg	FUNGICIDA
Rovral 250 Flowable	Iprodione	Botrytis	2.0 L	25ml		600	21 days	24 horas	15 mg/kg	FUNGICIDA
Thiram	Thiram	Damping off	4gms/kg	n/a	Tratamiento de Semilla	n/a	n/a	4 horas	7 mg/kg	FUNGICIDA
Cleosin	Metil-Tiofanato	Antracnosis, Manchas Foliares							5 mg/kg	FUNGICIDA
Marteo, Tecto	Tiabendazole	Damping off					7 dias		0.4 mg/kg	FUNGICIDA
Ziram	Ziram	Antracnosis, Manchas Foliares	3.13 kg	n/a		600	7 dias	24 horas	7 mg/kg	FUNGICIDA
Gramoxone / Agiquat	Paraquat	Malezas en General	3 L	300 mls		600	n/a	24 horas	0.25 mg/kg	HERBICIDA
Stomp	Pendamethalin	Malezas de Hoja Ancha	3.3 lt	330 mls		600	n/a	4 horas	1	HERBICIDA

ADMINISTRACION DE RIESGOS
HORTIFRUTI GUATEMALA

Ing Ag. Sergio Torres Garcia

WAL★MART
CENTROAMÉRICA

LISTADO DE PLAGUICIDAS PERMITIDOS HORTIFRUTI GUATEMALA

PROVEEDORES	MANANTIAL DE VERDURAS
	LABRADORES MAYAS
DEPARTAMENTO	CHIMALTENANGO

CULTIVO	LECHUGA

REALIZADO	17/06/2008
VERSION	1
VALIDO HASTA	31/12/2009

NOMBRE COMERCIAL	NOMBRE QUIMICO	CONTROL	DOSIS MAX/ha	USO RESTRINGIDO	volumen agua/ha	INTERVALO A COSECHA	MRL PERMITIDO CODEX	USO
Achook 0.15 EC / Nimbacidine	Azadiractin	Afidos y trips	1 L		600	1 dia	exento	Insecticida Biologico
Actara 25 WG	Thiamethoxam	Afidos y trips	0.3 kgs		600	7 dias	4 mg/kg	Insecticida
Vertimec	Abamectin	Acaros y Mosca minadora	0.1 L		600		0.01 mg/kg	Acaricida
	Fosetyl-Al	Infecciones bacterianas			600		10 mg/kg	Fungicida
	Boscalid						5 mg/kg	Insecticida
Thiodan	Endosulfan	Afidos y trips	1 L		600		4 mg/kg	Insecticida
Captan	Captan	Infecciones bacterianas			600		0.05 mg/ kg	Fungicida
Agriquat / various	Paraquat	Control de Malezas	1-3 L		200		None Set	Herbicida
Roundup	Glyphosato	Control de Malezas			200			Herbicida
Apron Star	Metalaxyl M/ difenoconazole/ thiamethox	Damping Off, Thrips, Ascochyta	Tratamiento a semilla		600	42 dias	5 mg/kg	Tratamiento de semillas
BB Plus	Beauvaria Bassiria	Afidos y trips	1 kgs		600	0 dias	exento	Insecticida Biologico
Malathion	Malathion	Afidos y trips	1 L		600		4 mg/kg	Insecticida
Cop Trace	Acetato de Cobre	Infecciones bacterianas	1.5 L		600	4 dias	exento	Fungicida
Coptrel	cobre liquido 40 %	infecciones foliares	0.5 L		600	1 dia	None set	Foliar
Dipel 2x	Bacilus thurigiensis	Larvas de lepidoptera	0.5 Kg		600	0 dias	exento	Insecticida Biologico
Dusting sulphur	Azufre	Mildium polvoriento	3-5 kgs		n/a	1 dia	None Set	Fungicida
Fusilade	Fluazifop -p-butyl	Control de Malezas	1.5 L		200			Herbicida
Gaucho	Imidacloprid	Mosca Blanca y Plagas del Suelo	Tratamiento a semilla	Solo tratamiento a Semillas	0	42 dias	None Set	Insecticida
Karate 1.75 EC	Lambda cyhalothrin	Gusanos cortadores	1.5 L		800	28 dias	0.02 mg/kg	Insecticida
Karate Zeon 5% EC	Lambda cyhalothrin	Gusanos cortadores	0.2 L		800	28 dias	0.02 mg/kg	Insecticida
Kocide DF / Champion	Hidroxido de cobre	Infecciones bacterianas	3 Kgs		600	4 dias	exento	Fungicida
Nabu	Sethoxydim	Control de Malezas	0.75 L		200		None Set	Herbicida
Ortiva 250 SC	Azoxystrobin	Roya, Alternaria	1.0 L	Restringido 4 aplicacion Maxima	600	10 dias	0.2 mg/kg	Fungicida
Ridomil Gold	Metalaxyl M y Mancozeb	Mildium velloso	2.4 kgs	Maximo 1 aplicación	600	21 dias	0.1 mg/kg	Fungicida
Ripcord	Cypermethrin	Afidos y trips	0.25L		800	7 dias	0.05 mg/ kg	Insecticida
Rovral 50 WP	Iprodione	Botrytis	2.0 L	Maximo 3 aplicaciones	600	7 dias	0.3 mg/kg	Fungicida
Dibron	Nafel	Gusanos cortadores	1L		800		1 mg/kg	Insecticida
Spintor	Spinosad	Gusanos cortadores, trips	0.2 L	Maximo 3 aplicaciones	600		4 mg/kg	Insecticida
	Maneb	Mildew Polvoriento	2 k		600			Fungicida
Sporekil	Amonio cuaternario	Mildew Polvoriento	1.0 L		600	0 dias	exento	Fungicida Biologico
Detergente	Jabon	Afidos, trips y Larvas de Lepidoptera	7.0 L		600	0 dias	exento	Insecticida Biologico
Thievil 80 WP	Azufre	Mildew Polvoriento	3.0 kgs		600	1 dia	exento	Fungicida
Thuricide HP	Bacilus thurigiensis	Larvas de lepidoptera	1.0 kg		600	0 dias	exento	Insecticida Biologico
Xentari	B.T aizawai	Larvas de lepidoptera	1.0 kg		800	0 dias	exento	Insecticida

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http://www.pesticideinfo.org (PAN most complete pesticides database, linked to EPA)

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Safety:

http://www.epa.gov/oppbppd1/biopesticides/ingredients/index.htm (EPA regulated biopesticides)

http://www.ipm.ucdavis.edu/index.html (IPM, PMPs and pesticide recommendations)

http://edis.ifas.ufl.edu/pdffiles/PI/PI07300.pdf (Restricted Use Pesticides)

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http://www.agf.gov.bc.ca/pesticides/f_2.htm (all types of application equipment)

http://www.greenbook.net/Search/AdvancedSearch (pesticide Material Safety Data Sheets)

http://www.epa.gov/pesticides/reregistration/status.htm (EPA Registration Eligibility Decisions)

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